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## Management of Change in the Irish Construction Industry

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# *Management of Change in the Irish Construction Industry*

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*By*

*Louis Gunnigan B.Tech(Ed.) MCIOB*

*Thesis submitted to the Department of Civil, Structural and  
Environmental Engineering in fulfilment of the requirements for the  
Degree of Master of Science (M.Sc.)*

*University of Dublin, Trinity College,*

*1999*

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## Declaration

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I declare that this thesis is entirely my own work and that it has not been previously submitted as an exercise for a degree at this or any other University.

I agree that the Trinity College Library may lend or copy the thesis upon request.

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Louis Gunnigan

August 1999

## Summary

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Ireland is changing and this change is nowhere more apparent than in the rapidly growing construction industry. The industry is being forced to change at an unprecedented pace. This thesis sets out to develop a framework on which construction organisations can approach and manage change.

It examines the issues that will cause change, reviews the available literature to find how change can be managed and controlled, and develops a model for guiding change programmes in the construction industry. The model is tested against three case studies, the first two of which are concerned with finding increases in efficiency and demonstrating how the changes necessary to bring about these efficiencies would be implemented. Data, gathered both by observation and by interviewing staff in three companies, was used to establish the means by which the current systems and processes worked. It also allowed the author to build up a clear picture of the working relationships of all of those in each system. In turn, this showed both where changes would be necessary and the effect such changes would have on the working relationships. A plan for change was then proposed in each case.

In the third case study the initial data, gathered by interview and surveys, again identified the original systems and the working relationships. A consultation process was set up to establish the extent of the changes necessary, the potential effects of the change were assessed and a plan of action was devised to ensure acceptance of the change. The change programme was then implemented and monitored through its first year of operation.

Change is difficult to achieve in the Irish construction industry as it is restricted by the structure of construction organisations (being project-driven rather than enterprise-driven) and by the proliferation of construction-related activities among governmental departments. However, the model for change proposed by this work was particularly effective in these circumstances, as it forced the author to fully analyse and constantly re-assess each interface with change.

In the course of the compilation of this thesis, it was found that the means by which change programmes are implemented are crucial to success. It is essential that the interfaces between tasks, processes and systems are fully analysed to determine the means by which the individual can become a supporter, rather than a potential opponent, of the change.

## Acknowledgements

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The acquisition of knowledge is like a journey into unknown territory. You begin with a vague assumption of your final destination and you gather several opinions as to the most suitable route. It is only when you set out on your journey that you learn to redefine your goals, as you are presented with the choice of several new destinations of which you were previously unaware. It is in the analysis of the choices of destination that the journey truly begins and it is in doggedly following the chosen path that the advancement of knowledge takes place.

As you make this journey, you encounter many who help you along the way. Some you encounter briefly but they give you invaluable assistance such as Professor Simon Perry, Dr. Jim Robinson, and Dr. Roger West, all of whom helped me to initially define the aims of my research. Others are there to call on when required such as the always efficient and ever helpful staff of the Trinity College Library. Others lend assistance when it is least expected, such as Mr. Gerry Walker of the Dublin Institute of Technology, who created a part-time position that greatly helped me fund my journey. Along the way, you also gather information about your route from such people as those who participated in the research that I carried out. To all of these people, I am very grateful.

All through the journey there is one person who has been assigned to you to ensure that you do not get lost! For me that person was my supervisor Dr. Trevor Orr and I am truly grateful for all his help and advice along the way.

Now that I have reached my destination, I know that I have gained enormously from the experience. For that I will always be indebted to my soul mate Áine, who created the opportunity for my travels and who encouraged me along every step of the way.

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## List of Abbreviations

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BPR .....	Business Process Re-engineering
CAD .....	Computer Aided Drawing
CIC .....	Construction Industry Council
CIF .....	Construction Industry Federation
CIOB.....	Chartered Institute Of Building
CITE.....	Construction Industry Trading Electronically
CSCS .....	Construction Skills Certification Scheme
CTIS .....	Construction Training Incentive Scheme
DOE .....	Department of Environment
E-Commerce ..	Electronic Commerce
EDI .....	Electronic Data Interchange
EDIFACT .....	Electronic Data Interchange For Administration, Commerce and Transport.
E-Mail .....	Electronic Mail
EMU .....	Economic and Monetary Union
ESRI .....	Economic and Social Research Institute
EU .....	European Union
FÁS .....	Foras Áiseanna Saothair - Training & Employment Authority
GDP .....	Gross Domestic Product
GEN .....	Global Engineering Network
GENIAL .....	GEN Intelligent Access Libraries
GNP .....	Gross National Product
GRN .....	Goods Received Note
IAI .....	International Alliance for Interoperability
IEI .....	Institution of Engineers of Ireland
IT .....	Information Technology
PDP.....	Professional Development Programme
PEST .....	Political, Legal, Economic, Cultural & Technological analysis
PPP .....	Public Private Partnership
SAMI .....	Systematic Analytic Methods and Innovations
SCS .....	Society of Chartered Surveyors
STEP .....	Standard for the Exchange of Product Model Data
SWOT .....	Strengths, Weaknesses, Opportunities & Threats analysis
TQM .....	Total Quality Management
VE .....	Value Engineering
VM .....	Value Management
WONDA .....	WWW Engineering Database Interoperability

WWW ..... World Wide Web

## Introduction

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## The Management Process

Although the process of management has been with us for thousands of years, it is the period surrounding and following the Industrial Revolution that has most shaped our approach to management. In the last two hundred years or so, the study of management has developed along three main perspectives:

1. The classical management perspective that has two main branches: scientific management and classical organisation theory
2. The behavioural management perspective, which examines human relations and behavioural management
3. The quantitative management perspective, which comprises management science and operations management.

More recently, new perspectives have also emerged:

4. The systems approach, which defines management activities in relation to inputs, processes and outputs
5. The contingency theory, which advocates taking account of all of the variables in the situation to be managed and thereby choosing the management style to suit the situation
6. Other theories which are primarily concerned with excellence, quality and productivity, the most noticeable being the quality movement which had its roots in the US in the 1950s but reached its peak in this country in the early 1990s.

According to Griffin (1990), there are three main factors that shape the development of management theory:

- economic factors
- social factors and
- political factors.

The economic climate in which a company operates and the markets to which a company aims its produce will affect the size, composition and organisation of the company. In this country we have seen changes in the process of management that have been brought by foreign firms locating here or by the fact that Irish companies now compete for a greater share of markets in Europe and the world generally.

Social forces have also made an impact on the manner in which businesses are managed, particularly in the response to the needs and rights of the workers. This is most noticeable in the legislation protecting the safety of the workers and in the area of worker equality.

Political decisions influence management in that they can change the market in which a company operates or change the processes that the company has been using. An example of such change would be where a government would introduce environmental regulations that would necessitate changes to a product on environmental grounds.

Porter (1990) states that change also occurs as a result of chance events such as:

- acts of pure invention
- major technological discontinuities (e.g. biotechnology, microelectronics, etc.)
- discontinuities in input costs such as oil shocks
- significant shifts in world financial markets or exchange rates
- surges in world or regional demand
- political decisions by foreign governments
- wars.

On a world wide level, changes are occurring at a rapid pace, particularly in the area of information technology. The increasing number of computer based applications that are now available to construction companies is changing the nature of the business which we carry out. Research projects funded by the European Union into the area of information technology are showing how we can reuse construction design information and how we can access information generally throughout the industry (Buckley, Salminen & Kesteloot, 1997).

Deevy (1995) suggests that society is now facing an “information technology revolution” which will bring a period of change he has likened to that of the Industrial Revolution. If this is the case, then

all organisations must recognise that survival in business will be dependent on their ability to adapt to changing circumstances.

#### Change in the Construction Industry

According to the most recently available information from the Department of the Environment (DOE) (1998), the construction industry in Ireland has undergone an enormous change over the four-year period 1994-1998. During this period the total volume of construction output increased by 63% and employment grew from 71,000 in April 1993 to 136,300 in December 1998. The Construction Industry Federation (CIF) (1999), predicts that this growth will continue through 1999 at a rate of at least 8%. The Economic and Social Research Institute (1996) states that reductions in interest rates following European Monetary Union could result in further growth within the industry, creating a potential 8,000 further new jobs.

The level of technological change in every industry continues to gather pace and the construction industry is no exception. New equipment and new methods contributed to an increase in productivity of 3.3% per annum over the period 1992 to 1996. The Construction Industry Council /Department of the Environment (CIC/DOE) (1997) states that the time taken to construct a typical building has halved in the last 10 to 15 years. The value (in real terms) of the output per person employed increased by more than 30% in the ten years from 1986 to 1996.

The potential uses of Information Technology (IT) in the industry are enormous. For example:

- Buildings can now be designed and costed electronically thereby facilitating a greater re-use of design and cost information and realising savings in design costs. Use of Virtual Reality allows the aesthetic comparison of different aspects of design while the financial software available allows quick comparison of the costs of different designs
- Planning carried out using computers will allow quick comparisons of the time and resources required to complete different designs and will show the effect of design changes on the remainder of an existing project
- Materials can be sourced using Internet style search engines
- Electronic commerce now allows the ordering of and paying for materials to be carried out electronically



- Meetings can be held using video-conferencing
- Documents and drawings can be recorded / stored / distributed / viewed / updated and printed using computers; information gathered on previous projects can be accessed and used to make cost savings on new projects.

Further advances are now occurring on an almost daily basis, bringing newer and easier ways for us to tap the enormous potential of these machines.

All of this has caused problems for the management of our construction companies. Companies have had to grow and cope with new technology at a rate which could not have been envisaged a short number of years ago. These same companies now face even more challenges in an ever-changing construction environment.

#### Objectives of this Research

The purpose of this thesis is to find an approach that these companies can follow in recognising and reacting to change. This is carried out by establishing the areas in which change is most likely to occur over the next ten years and by examining the current approaches in relation to change management. A model for managing change in the construction industry is developed and is tested in three different case studies. The findings of the case studies are analysed and an approach to change for Irish construction companies is derived.

#### Structure of the Thesis

The thesis is divided into three sections.

Section 1, comprising Chapters 1 and 2, examines the potential for change in the Irish construction industry and carries out a review of the approaches available to meet the challenge of change.

Chapter 1 of this thesis examines the types of change facing Irish construction companies. The causes of such change are identified and the likely effects of the change are assessed. In order to examine management change in a construction environment, it is necessary to analyse the challenge faced at each level of activity and to identify the consequences for the organisation.

Newcombe, et al. (1990), identifies three levels within the management system of a construction company - the *corporate* level, the *business* level, and the operational or *project* level.

Corporate level is concerned with decision making and planning for the whole organisation and is strategic in nature. It includes the scope of the organisation's activities, corporate policy, corporate planning, company organisation, and major financial decision making.

Business level is practical in the sense that it is concerned with implementing the strategies devised at corporate level. The focus here is on how to achieve the aims set at corporate level. A typical example of an action at business level would be that of a Marketing Director in the development of new markets.

Operational or Project level is specifically focused on short-term objectives, for example the control of a project, an aspect of a specific project or of a process. It also includes the control of functional departments.

A variation of this approach is used throughout this thesis to show the effect of change throughout the organisation. It identifies the levels of activity as:

- Task - at which individual actions take place as part of a process, for example, filling out an order form as part of the materials ordering process
- Process - at which a series of tasks are carried out in order to complete an action, for example, the placing of an order with a supplier for a quantity of a construction material
- System - at which the day to day management decisions and actions are taken in order to control a number of processes, for example, the management and control of the materials purchasing system. A construction project can also be defined as a system that is established in order to construct the building or structure. This level corresponds to the operational or project level as defined by Newcombe, et al. (1990)
- Organisational - at which decisions are made and actions are taken to determine the strategy of the organisation, for example, the forming of a strategic business alliance with a materials supplier. This corresponds to the corporate and business levels as defined by Newcombe et al.

These levels of activity are tied together with a complex series of interfaces through which individuals communicate. Any level of an organisation can and will regularly interface with levels in other organisations.

The chapter examines the challenges that Irish construction companies are likely to face and the consequences of such change both at each of the levels and at the interfaces.

In Chapter 2, the predominant change management techniques are identified. The processes of implementing these techniques as a means of achieving greater efficiency are discussed. The concepts of Strategic Planning, Business Process Re-Engineering, Value Management and Total Quality Management are examined in detail. The literature in respect of each of these concepts is reviewed. The chapter ends with an assessment of the potential success of each of these approaches in introducing change at each of the levels of organisational activity.

In Section 2, comprising Chapters 3-5, three case studies are examined to establish the potential for change and the problems of introducing change into Irish construction companies. This section gives an account of research that was carried out with three Irish construction companies in relation to the management of specific aspects of their organisation. In the course of this research, the challenges and potential gains from applying change management concepts to systems and processes in a typical Irish construction company are evaluated. The companies chosen for this research operate in totally different sectors of the industry and are quite different in structure.

Chapter 3 recounts a case study that examines materials management in an Irish construction company. The company (Company A) is a medium to large organisation by Irish standards. It normally has only two or three projects current at any one time and has a turnover in the region of £70 million annually. This company buys land in the Dublin City region and develops it into residential accommodation. The designs of the residential units have strong similarities from project to project leading to the reuse of subcontractors and suppliers in similar situations on an ongoing basis. A high percentage of its work is sub-contracted to the same companies from project to project and to a high percentage of materials is consistently purchased from a small number of regular suppliers. It was assumed therefore that this company would have well defined systems of work and that areas of improvement would be difficult to find. The case study reviews the materials control system operated by Company A in an exercise to establish where improvements (if any) could be found. An approach to the implementation of such improvements is also established.

In Chapter 4, the subject of plant management is explored through Company B, a construction company that is smaller and much more diverse in its operations. It operates in the maintenance, refurbishment and new-build sectors on projects ranging from £5,000 to £1,000,000 in value. At any one time, this company can have up to 40 sites active. With a turnover of approximately £10

million in 1997, this company directly employs approximately 100 people. The directors of the company are acutely aware that some of its current systems are unable to deliver the efficiency required and are seeking procedures to change these systems and to implement the change within the company. They have identified their plant management system as one such system that could be improved. The case study examines the methods used to control plant, outlines areas of weakness in the system and proposes a range of possible actions that could increase efficiency. The principles of change management that apply to the implementation of each of these proposals are discussed and the pitfalls that could be encountered are identified.

Chapter 5 provides the most comprehensive of the three case studies. It introduces a large company (Company C) that operates mainly in the commercial/industrial sector. This Company wishes to establish a structured training programme for its younger engineers and quantity surveyors. This is not the first time that this company has attempted to establish such a programme. A detailed investigation of the cause of the failure of previous programmes is carried out and a new programme designed. The progress of the development and implementation of a new programme over its first year is followed and a detailed account is provided of the effect of the change on the company. The problems of implementation and the actions taken are documented.

Section 3 comprises two chapters, Chapters 6 and 7. Chapter 6 conducts a critical analysis of the issues arising in the previous chapters and identifies the problems likely to be encountered in the implementation of change. This chapter also outlines the reasons why change is difficult to achieve in the Irish construction industry and suggestions are made as to how these difficulties could be approached.

Chapter 7 draws conclusions from the work carried out in previous chapters and makes recommendations in relation to both the challenges faced by the Irish construction industry in relation to change and the need for further research into this field.

## SECTION 1

### BACKGROUND

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This section, comprising two chapters, examines the potential for change in the Irish construction industry and carries out a review of the approaches available to meet the challenge of change.

Chapter 1 examines the types of change facing Irish construction companies. The causes of such change are identified and the likely effects of the change are assessed. Levels of organisational activity are identified and an assessment is made of the potential impact of change on each of these levels.

In Chapter 2, the predominant change management techniques are identified. The processes of implementing these techniques as a means of achieving greater efficiency are discussed. The concepts of Strategic Planning, Business Process Re-Engineering, Value Management and Total Quality Management are examined in detail. The literature in respect of each of these concepts is reviewed. The chapter ends with an assessment of the potential success of each of these approaches in introducing change at each of the levels of organisational activity.

## Chapter 1.

### Changes facing the Irish Construction Industry

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## 1.1. Introduction

The Strategic Review of the Construction Industry (CIC/DOE, 1997) identified the following issues currently facing the Irish Construction Industry:

1. The imminent changes in the structure and volume of European Union (EU) funding in the period post 1999
2. European influence generally, e.g. European Monetary Union (EMU), EU Construction Products Directive, harmonisation of legislation to European standards, etc
3. The need to understand and exploit developments in Information Technology
4. The changing workforce, e.g. the shortages of labour in certain areas
5. The drive for competitiveness as proposed in the U.K. by the Latham Report (1994) and the Egan Report (Construction Task Force, 1998).

This chapter examines each of these issues in turn and identifies the challenges faced by Irish construction companies at each level of activity within the organisation. The chapter concludes with a summary of the challenges to be faced at each level.

## 1.2. EU Funding

Over the period 1994 - 1999, the EU has provided estimated £4.7 billion (1997 prices) in financial assistance for construction works in Ireland (CIC/DOE 1997). The bulk of this expenditure has been on transport infrastructure (46%), industrial development (17%), and environmental services (13%). Agenda 2000 (1997) summarised the current and likely future arrangements of EU funding in relation to Ireland as follows:

### 1.2.1. Structural funds

During 1994-99, Ireland has been receiving approximately £800 million per year in EU structural funds. These payments were made on the basis of the "Objective One" status assigned to Ireland for the last round of disbursement of EU funding. Such status is assigned to the EU's poorest regions - those with less than 75 per cent of the EU average per capita GDP.



However, during 1994-96 - the period used for assessing funding entitlements for the next round - Ireland's per capita GDP was approximately 90 per cent of the EU average, a level that precludes entitlement to Objective One status. At the Berlin summit on 23/24 March 1999, it was decided that Ireland would receive £2.38 billion during the seven-year period 2000-2006. This represents a cut of over 50% in average annual structural fund receipts.

To offset the drop slightly, Ireland may benefit from the allocation after the mid-term review of a 10 per cent reserve designed to reward those countries, which make good use of the funding. However, in 2006, Ireland is likely to fall into the "Objective Two" category - that for areas going through industrial restructuring or rural decline. Arrangements for funding after that are not yet decided but the likelihood is that the then new EU states, such as Poland, Estonia and Slovenia, will take a substantial proportion of the available funding.

#### 1.2.2. Cohesion funds

Cohesion funds of up to £200 million per year since 1994 have been used for major infrastructural projects, such as roads, water supply projects, etc. For the period 1994-99, states with less than 90 per cent of average EU GNP per head qualified for cohesion funds. Ireland will qualify until the 2004 mid-term review of the next round of EU funding as eligibility is based on the average GNP per head during 1995-97, when Ireland's figure stood at 85.7 per cent of the EU average. It has since risen to 87 per cent, so Irish access to cohesion funding may be cut off in the mid-term review. Up to 2004, Ireland will receive 9 per cent of the total EU cohesion fund, which amounts to some £220 million per annum. After that, this source of funds appears certain to be cut off completely, based on our current GNP level.

In its submission to the Government in January 1998, the CIF suggested that, post 1999, Ireland's infrastructure will still be in need of a significant degree of funding in order to reach European levels. The suggested solution to this problem is the adoption of a public private partnership (PPP) approach to public sector projects. This has been recognised by the Government which has now stated that £1.65 billion worth of PPP projects will be included in the 2000-2006 National Development Plan (Brennock 1999).

A PPP is a partnership between public sector organisations on the one hand and private sector investors and businesses on the other, for the purpose of designing, planning, financing, constructing and (possibly) operating an infrastructure project or a service normally provided by the State. The advantage for the State is that PPP shifts expenditure from existing capital spending to

future current spending. The advantage for the contractor is that PPP projects can lessen the effect of the cyclical nature of the industry on the profits of the company. While private sector investment in public infrastructure projects is not new, very few such schemes have been tried yet in Ireland, mainly due to the ability of the Government to borrow at cheaper rates than the private sector.

On a PPP project, the contractor faces a different type of risk than on the more traditional type of project. The period over which the contractor is financially committed to the project is significantly longer and the contractor may have a role in the management of the completed project. This would not previously have been the case. The role of the contractor's management team is expanded in a PPP and would involve providing input at the design stage; delivering the best construction price or the most competitive cost base; arranging the necessary financing and providing high quality project management.

PPPs have been successfully developed and carried out in many EU countries. IBEC / Construction Industry Federation (1998) states that while no structure currently exists for EU co-funding of PPP projects, such proposals are under consideration by the European Commission and the development of such a structure would greatly benefit the Irish construction industry.

34 leading contractors produce approximately one third of the output of the Irish construction industry (CIC/DOE 1997). It is these organisations which would be most likely to consider involvement in PPP due mainly to their size and the scale of their growth since 1994. Let us therefore consider the challenge facing such an organisation in the move towards becoming involved in PPP projects.

At Organisational level, construction companies will have become increasingly aware of the projected decrease in EU funding and having spent the preceding years building up the company, will not want it to return to pre-1994 levels. PPP is identified as an option to maintain output. The following issues will emerge:

- Involvement in PPP type of projects requires a cultural change within the company as the project life moves from short duration to long duration
- Risk level is higher due to reimbursement occurring over a period of several years and profit level should be higher to reflect higher risk. Profits should be more evenly spread from year to year

- It may be necessary to become involved in new types of projects and in forms of construction that are new to the company. This may require additional management experience or technical knowledge in the type of work to be undertaken and would involve increased levels of marketing to promote awareness of the service offered by the company
- An assessment of skills within the company must be carried out and development of skills in the areas of long term project management, project financing and economics must be undertaken
- New functions will emerge within the organisation. The scale of the new functions must be defined and the skills required in each position must be established
- Long-term enterprise related issues rather than short-term project issues must drive planning, particularly in such areas as manpower management and financial management
- Suitable projects must be identified and procedures developed to evaluate such projects. IBEC/CIF (1999) has put forward a list of potential PPP projects
- Potential project partners and the types of partnership arrangements necessary under a PPP type project must be identified
- An assessment of the implications of involvement in PPP type projects on the current work methods of the company must be conducted.
- The traditional adversarial style relationships common in the construction industry would be unsuitable in a partnership arrangement. This will require investigation of the interface areas where organisations interrelate on a contractual basis and the development of contractual arrangements that facilitate more openness and co-operation.

As the contractor's role would now encompass parts of the traditional roles of client, designer, constructor and end user, the following issues would emerge at System level:

- Emphasis on overall reductions in costs, with all parties trying to reduce both their own and each other's costs, in order to maximise overall profit
- Systems would have to become more aware of the effect of their processes on those in other systems and adapt them to achieve an overall increase in cost effectiveness.

At Process level, the drive for increased cost effectiveness would become more acute as it is at this level that competitive advantage can be achieved. New construction processes must be researched and developed. New developments in materials technology and information technology must be maximised in order co-ordinate and integrate the design and construction phases of the project, thereby bringing about faster delivery of projects. It is at this level that issues of safety and quality must also be addressed, as reductions in construction costs cannot be achieved at the expense of either of these issues.

At Task level, there would be new skills to be learned both in the technical aspects of the tasks being performed and in the interfaces between the tasks.

These challenges, which would be encountered by a contractor in a move towards involvement in PPP projects, must each be assessed and strategies for the change adopted. Such strategies are discussed in detail in Chapter 2.

### 1.3 European Influences

The influence of Europe on the construction industry has been significant over the past decade. During that period we have seen the introduction of legislation in the areas of Health & Safety, environmental control and in employment practices that bring harmonisation of practices across all of the member states in the EU. The Construction Products Directive of 1988, which was designed to harmonise the minimum essential requirements of building products for building regulation purposes, has not yet been fully implemented but is gradually promoting standardisation in the area of building products across Europe. When this Directive is fully implemented, there will be a more open market for building products across the EU.

It is, however, the adoption of a common currency or Economic & Monetary Union (EMU) across the EU which is generally regarded as the event which will have the most profound affect on the construction industry.

*“The most obvious sector to gain from EMU is the building industry. A permanent reduction in interest rates of 1% below the level they would otherwise attain would result in a higher level of investment, especially in building and construction.” ESRI (1996)*

As predicted by most economic experts, interest rates have dropped by approximately 2% since the Irish Punt entered the EMU on 1<sup>st</sup> January 1999. The ESRI (1996) has estimated that for every 1% drop in interest rates, the resulting investment in construction could create employment for 8,000

more people in the sector. While growth is welcomed by the industry, EMU will also bring challenges for construction firms.

At Organisational level, construction companies must quantify the effect of Europe on the prospect of increased competition from foreign companies within the EU. Legislation and harmonisation will gradually create a strong homogeneity between projects across the EU as the technical differences disappear. For example, a water treatment plant in Belgium would be built to the same standards as in Ireland. Consequently a company might tender for work based more on their specialisation rather than their location.

Ireland's construction output is increasing at almost four times the average EU rate (CIC/DOE 1997), a fact that is surely being noted in other countries. With a fixed rate currency, there will be less financial risk to foreign companies in carrying out work in Ireland. Again it is the larger companies who will first experience this predicament, as it is the larger projects which will attract the most foreign competition. Irish companies must therefore continue to strive for competitive advantage in order to counteract this threat. It is noticeable that a number of Irish companies have already taken action in this area by entering into joint ventures with UK companies in order to win key projects. Tallaght Hospital and the Lee Tunnel are recent examples of this. Such a drive for competitive advantage may also lead companies to examine the possibility of partnership arrangements with subcontractors and suppliers as achieved by Skanska in Sweden in a move to reduce costs (Laage-Hellman & Gadde 1996).

At System level, the challenges will arise in assessing the changes as they occur and in continuous development of the system in order to maximise efficiency. This will include the increased use of detailed planning techniques combined with more widespread use of information technology particularly in the areas of communication and electronic commerce.

The challenges at Process level will arise in the analysis of current processes with the aim of reducing or eliminating non value-adding aspects of the processes. At Task level they will arise in the adoption of new methods of working both in the way in which tasks are performed and in the relationships with others in the performance of such tasks.

#### 1.4 The Information Technology Challenge

In a telephone survey of eight leading construction companies in the Dublin region, carried out during February 1998 (see Appendix 1.1), the following findings emerged:

- all of the companies stated that they use specialist computer software in the control of accounts
- seven out of eight used specialist estimating software
- in the area of project cost control / quantity surveying, two used specialist software while the remaining six used standard spreadsheets
- six out of the eight companies used project management software in their project planning
- only one of the companies involved stated that their software was capable of integrating data used in one task for reuse in all other tasks, while one other company stated that their estimating and quantity surveying software were linked
- six out of the eight companies stated that they used computers on site, with applications concentrating on planning, quantity surveying, document control and correspondence
- none of the companies were using the Internet in any way in their business.

Due to the small number of companies surveyed, the findings of this survey cannot be used to draw definitive conclusions. All eight companies surveyed, however, would be among the group of 34 leading contractors, who among them produce one third of Ireland's construction output as noted by CIC/DOE (1997). This gives us a broad picture of computer usage among our leading contractors, from which we can state the following in general terms:

- Irish construction companies use computers to support existing processes rather than to introduce more cost effective processes which are dependent on the use of Information Technology (IT)
- there is no evidence of the use of either electronic commerce (placing orders for and paying for materials electronically) or of the Internet in the data gathered
- the concept of integrated software is beginning to emerge with some companies, but as yet it is limited to estimating, quantity surveying and accounting software.

The use of IT found in this survey follows the Baxendale and Zoglowek (1992) model of the stages of IT growth shown in Figure 1.1 below. Ireland's construction companies appear to be operating at stages 1 or 2 with a small minority moving to stage 3.

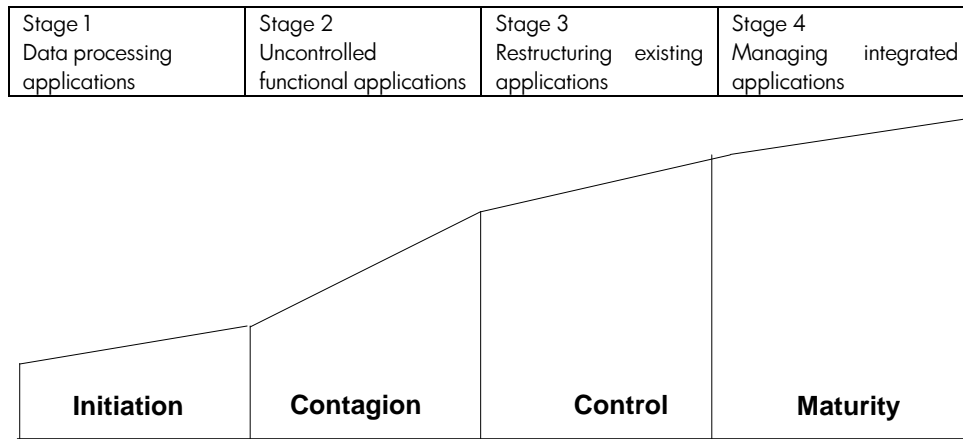


Figure 1.1. *The growth of data processing (Baxendale & Zoglowek, 1992)*

CIC/DOE (1997) recommended that an IT programme for construction should be created with the efforts of such a programme concentrated on the generation of documents “...in standardised format suitable for interactive computer application using various computer hardware.” A budget of £200,000 was proposed for this work. The fact that a body such as the Strategic Review Committee made such a recommendation reflects the lack of knowledge of IT across the Irish construction industry as a whole.

There are a number of international organisations already set up with the specific aim of providing interactivity (or interoperability) between software applications. The International Alliance for Interoperability (IAI) (<http://www.interoperability.com>), the Standard for the Exchange of Product Model Data (STEP) (<http://www.vtt.fi/cic/links/step.html>) and the Construct IT committee under the Department of the Environment in the UK are examples of such organisations. Other organisations such as CITE (Construction Industry Trading Electronically) (<http://www.cite.org.uk>) have set up standards to which software companies design new packages so that information generated by one package can be read, added to and returned to the sender by an individual using another package.

The main causes of poor interactivity between software applications arise from the different formats of databases used by computers to store information. Software is now commercially available to read information from different types of databases and the European funded Esprit Project No. 25.741 (known as the WONDA Project) (<http://www.bild.ie/wonda>) has been set up to develop a means for interaction between different types of databases through the Internet.

Part of the interoperability challenge to the Irish construction industry therefore is in the preparation for the arrival of the new technology rather than the development of the new applications in the interactive format.

There are other challenges from the area of IT, which the construction industry must face - namely, the increased use of object oriented technology and the Internet.

#### 1.4.1. Object Oriented Technology

At the moment an individual can use Computer Aided Drawing (CAD) software to draw, for example, a door. The lines and layers of the drawing can be copied and moved within the drawing or between drawings but to the computer they are still a series of lines and layers. Object Oriented Technology changes this by defining, within the computer, the concept of an object (in this case a door). This object can carry with it not just such information as its physical dimensions, but also how it interacts with its environment, e.g. its fire rating, the jamb details, etc. It can also have other types of information attached to it such as its cost, availability and any other information required by any party who in any way encounters this door at any stage of the project.

The use of Object Oriented Technology will cause a profound change in construction, as it will enable different applications to make use of information in a way that has not previously been possible. For example, a door on a CAD drawing is currently a series of lines and layers to most estimating packages: a door on an Object Oriented CAD drawing is still a door to an Object Oriented estimating package. Similar information transfer is obtained with other applications. It will soon be possible to link CAD, estimating and planning software to show 3 dimensional drawings illustrating the projected completion of a building at specific future dates.

To the individual with a limited knowledge of IT, this scenario seems like a distant fantasy. However there are several organisations working towards these goals at present. An Object Oriented CAD package called Reflex is currently being tested by Taylor Woodrow in the United Kingdom (New Civil Engineer, 1996). Several European and American research projects are working on the realisation of interoperability of different applications using Object Oriented Technology.

#### 1.4.2. The Internet

The Internet is basically a series of computers in several different locations all over the world that are connected to each other across standard and high speed telephone lines. As computers share information with each other, the greater number of computers connected, the more information is



available. The information is held on websites, which may be accessed through any computer connected to the Internet. Other information can be sent to another Internet user using electronic mail (e-mail). E-mail is not held permanently on the Internet and can be encrypted to ensure that it is not accessible to others.

Applications to the construction industry include:

- immediate access to technical information held in a computer at a remote location
- use of e-mail to distribute documents and correspondence
- sourcing of materials and services
- electronically ordering materials, issuing invoices and paying for goods or services (e-commerce)
- project or company Intranets can allow access to a limited number of people when it is not desirable to release certain information into the public domain

At Organisational level, it is important that Irish companies recognise the potential use of IT. However, IT is often seen as a complex field best understood by young minds and many of the directors of Irish construction companies may not have had the time or the patience to keep up with the rapid pace at which this technology has been developing. Many directors may therefore not be aware of the direction in which IT is developing. This should be addressed by developing an organisation-wide IT strategy to plan and control the increasing use of computers within the company.

At System and Process levels, it is important to rid people of their fear of new technology and to recognise the processes that should be changed in order to maximise the efficient use of IT. New processes must be devised, implemented, monitored and improved where necessary. Changes must first be made where they will have the most noticeable effect thereby convincing all involved that the new processes are to the benefit of everyone.

At Task level, training must be provided to make full use of the new IT systems.

## 1.5 The Changing Workforce

The number of people employed in the construction industry reached 135,300 by the end of 1998, having increased from 71,000 in April 1994 to in January 1999 (CIF, 1999). While such growth in

employment is welcomed by the economy as a whole, it has led to significant shortages of personnel across all sectors of the industry.

At management level, shortages are evident if only by the general increases in salary levels since 1993 and in the level of advertising currently being carried out by recruitment companies who specialise in construction management personnel.

The Construction Industry Forecasting Model (FÁS 1997), predicted labour supply shortages in bricklaying, plastering, plumbing, carpentry/joinery and shortages of fitters/mechanics. FÁS predicted that a combination of the projected growth of construction output and the level of apprentices in training, many of these shortages would not be resolved for at least three more years. The industry reacted to these figures by increasing the number of apprenticeship places - over 4,600 new apprentices joined the industry in 1998 compared to 1,600 in 1994 (CIF, 1999). However such is the continued growth in the industry that the CIF is now recruiting building workers for the Irish construction industry in the UK and in mainland Europe.

CIC/DOE (1997) has identified the scaling down of apprentice intake by the public sector and the decrease in the use of direct labour as the major cause of shortages of skilled workers in the industry. It recommended:

- a review of apprentice recruitment practices by both public and private employers with a view to creating a pool of apprentices who would work throughout an organisation rather than in a specific location where the number of qualified workers would be too low to warrant the employment of an apprentice
- long term planning for the supply of apprentices. This would be carried out by FÁS with the support of both contractors and subcontractors
- the identification of elements of traditional crafts where serious shortage may be eased by bringing up the skill level of good support people through the introduction of accelerated training programmes
- the active encouragement of more applications from women for employment in all sectors of the industry
- the provision of facilities to allow for the employment of more people with disabilities
- the adoption of a scheme for the identification of qualified building workers through certification and the use of ID cards.

At Organisational level, companies must define their skill needs in relation to their corporate plans. Causes for staff turnover and loss of staff to other organisations must be identified. Employment in the construction industry has been transient with considerable movement by workers between companies. This has resulted in the skills gained with one company being used by another, the consequence being that the company providing the most training is not always the company that benefits most from the provision of the training. A change in attitude may be needed by companies in order to keep trained staff and obtain maximum return for the investment in training. Experience from other industries should be drawn upon and approaches to staff retention might be considered - for example the Japanese policy of increasing the benefits to the individual as length of service increases. Human resources management must face the challenge of finding and retaining the staff necessary to fulfil the aims of the corporate plan. Plans must be developed and administered to ensure that the company utilises its staff to full capacity and potential.

At Systems level, the promotion of innovation, team working and an emphasis on quality must be encouraged to continue to strive for competitive advantage for the company. The training of staff must be structured and recorded. Training programmes suitable to the short term and long-term needs of both the company and the individual trainees must be devised and delivered.

At Process and Task levels, the organisation must examine the actual skills required in order to carry out the work of the organisation. Processes and tasks should be simplified where possible. Individuals could be trained in specific tasks or in a small number of tasks. For example, an individual might be trained in fitting doors in their frames and another trained in fitting architrave. These two individuals could then carry out the process of hanging doors that was previously one of the many processes carried out by skilled (but now increasingly scarce) joiners.

## 1.6 The Drive to Promote Competitiveness

Ever since the Latham Report (1994) stated that UK construction costs to the client could be reduced by 30%, the search has been ongoing to find where such savings could be made. Materials management has subsequently emerged as an area worthy of examination in the search for such savings.

In Sweden (Laage-Hellman & Gadde 1996), Finland (Wegelius-Lehtonen 1995) and in the UK (Dawood 1997), materials management has been identified as an area where some savings could be made. Each of these pieces of research approached materials management in a different way.

Laage-Hellman & Gadde gave an account of the progress made by Swedish construction company Skanska in its attempts at introducing Electronic Data Interchange (EDI) into its purchasing system. The cost of processing an invoice was found to be SEK 300 (approximately US\$45). Laage-Hellman & Gadde state that this cost can be reduced by 90% by using EDI. In Chapter 3 of this thesis, through the research carried out in case study 1, it is shown that potential savings are indeed significant. Laage-Hellman & Gadde noted that the simplification of the materials management process also led to:

- closer co-operation of the supplier and the contractor
- a higher quality of the information between contractor and supplier resulting in fewer ordering errors
- an increase in the speed of the materials handling process and in the ease with which information could be transmitted.

These factors in turn resulted in increased cost effectiveness in the construction chain.

Wegelius-Lehtonen (1995) concentrated on the improvement of logistics chains of different construction materials. She found that by observing and recording the logistics chain of a number of materials, she was able to benchmark the best practice for the logistics chain of each material. She then produced a list of guidelines to be followed by those who performed the tasks within the chain. Cost savings achieved were up to 17% of the purchase price.

Dawood's (1997) objective was to discuss and introduce a new strategy for materials management for the construction industry with a view to minimising wastage. He observed current practices and discovered that wastage accounts for 8-10% of project costs. By making a number of basic changes to some aspects of the building process and by introducing a computer based materials management system, he estimated that construction costs could be reduced by at least 10%. These savings would occur as a result of reduced wastage, fewer project delays, early selection of suppliers leading to lower prices and greater certainty of availability of materials, greater understanding of the type and amount of materials needed thereby eliminating late and inaccurate ordering, and a reduction in on-site overheads.

From these three papers alone, it is evident that closer examination of materials management systems in Irish construction companies could lead to significant savings.

At Organisational level, the challenge lies in the recognition of the potential that may exist in this area. Existing systems must be examined and the scale of this potential assessed. Corporate policy must be revised to ensure that maximum competitive advantage is gained from implementing new systems.

At System level, the challenge lies in the planning and implementing of the changes that will improve current systems and particularly the materials management system. Some of the existing processes may no longer be necessary and staff will have to be re-deployed as necessary. Training programmes will need to be devised and implemented.

At Process and Task levels, new methods of communication will be encountered and training must be provided to maximise the advantages of these developments. Both the tasks and the interfaces that together comprise the processes must be recognised and addressed to ensure the success of any change programme.

## 1.7 Conclusion

At Organisational level, the following action is recommended to maximise competitive advantage in meeting the current challenges facing the industry:

- investigation of the potential return from involvement in alternative contractual arrangements such as PPP type projects requires a cultural change within the company as the project life moves from short duration to long duration
- investigation of new forms of construction and new technology which can increase efficiency
- assessment of the effect of European influences on the prospect of increased competition from foreign companies within the EU
- examination of the possibility of partnership arrangements with subcontractors and suppliers in a move to reduce costs
- recognition of the potential use of IT and the preparation of IT strategies to plan and control the increased use of computers within the company
- definition of skill needs in relation to the corporate plans and formulation of strategies for reduction in staff turnover / loss
- assessment of skills within the company and development of skills required by the company

- definition of the positions to be filled and determination of the skills required to fill such positions
- long term planning in relation to staff retention
- identification of types of projects most suitable to the current and planned future of the organisation and of the procedures necessary to evaluate such projects
- identification of potential project partners and of the types of partnership arrangements necessary under a PPP type project
- assessment of European influenced changes to the market as they occur.

At System level the following action must be taken:

- promotion of innovation, team working and an emphasis on quality must be encouraged to continue to strive for competitive advantage for the company
- implementing IT driven change programmes
- analysis of current processes with the aim of reducing or eliminating non value adding aspects of the processes
- examination of current processes in all areas of the company in order to establish potential for maximising efficiency
- development of integrated project teams rather than an adversarial collection of organisations contracted to the project
- emphasis to be placed on overall reductions in costs, with all parties trying to reduce both their own and each other's costs, in order to maximise overall profit
- increased use of detailed planning techniques combined with more widespread use of information technology particularly in the areas of communication and electronic commerce
- provision of extensive training to make full use of developments in IT and in advances in the industry generally
- development, implementation, monitoring and improvement of work processes.

At Process level the required action includes:

- adoption of new methods of working both in the way in which tasks are performed and in the relationships with others in the performance of such tasks
- assessment of the implications of involvement in new types of projects on the current processes used by the organisation
- recognition of the processes which should be changed in order to maximise the efficient use of IT.

At Task level the biggest challenges to be faced are the fear of new technology and the fear of change within the workforce. Once these are overcome, the tasks and interfaces, which together comprise the newly structured processes, can be mastered.

This chapter has shown that the construction industry is being pushed towards change by several factors. The changes required at different levels of activity within the organisation have been identified. It is now time to investigate how to approach change in a planned and structured manner. There is a significant amount of documented research in the area of change management. This research details the techniques used to achieve effective change and identifies the barriers to change. Chapter 2 reviews this research and suggests the techniques and approaches most suitable at each level of activity within the construction organisation.

## Chapter 2

### Current Change Management Theory

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## 2.1. Introduction

In the previous chapter, the challenges facing Irish construction companies were identified. These challenges will occur within a company at one or more of four levels – namely: Organisational, System, Process and Task level. This chapter examines the documented approaches to change management and demonstrates the suitability of the various approaches to each of the levels of activity.

Three main approaches are considered beginning with Strategic Planning. This approach is traditionally used to contend with long-term organisation-wide issues. This chapter explores the concept of a strategy and identifies the circumstances for successful implementation. The main principles of this approach are examined and the possibility of using these principles in the management change in shorter-term systems or processes is explored.

In relation to short-term activities, two further approaches are identified in the literature: that of changing the entire process or system by total redesign (known as re-engineering); or that of correcting the current process or system so that it operates at maximum efficiency (known as improvement). Each of these approaches is examined and their suitability of application to each of the current challenges at the appropriate activity levels is assessed.

There are other approaches through which elements of the change process is managed such as benchmarking and partnering.

Benchmarking involves the establishment of best practice in an activity as a model for the existing system. This approach is based on examination of the activity in another setting, i.e., another part of the process/system/organisation, in another organisation or in another industry. An example of benchmarking is given in Chapter 3, where the principles of supply chain management from manufacturing industry are applied to a materials management system in a construction company.

Partnering involves the establishment of close links with another organisation in order to use the strengths of both organisations to the benefit of both parties.

Whilst these methods are used to promote change, they are generally used as part of the change process rather than as a full approach in their own right. Consequently they are not analysed in detail in this work.

## 2.2 Strategic Planning

### *Strategy*

In order to discuss strategic planning, it is necessary to define strategy and to outline the manner in which different types of strategy are grouped in the literature.

A strategy, according to Armstrong (1993), is a declaration of intent that is central to the corporate direction of a company. It defines the direction in which a company is to go if it is to fulfil its purpose. It devolves from the mission of the company and is therefore devised by the most senior level of control in a company. A strategy is therefore fundamental to the continued existence of a company. The ongoing planning and management of the implementation of the strategy is necessary if a company is to continue to develop and sustain itself.

There are a number of ways in which different types of strategies can be viewed.

Armstrong (1993) states that the strategy of an organisation is defined by three key concepts:

- *Distinctive competence* - what the organisation does best
- *Focus* - what the organisation wants to do in the future
- *Sustainable competitive advantage* - what is required of the organisation to achieve an advantageous position and to continue to be competitive.

Simply put, this identifies the current position of a company in the marketplace, the desired position and the action to be taken to get to and maintain the desired position.

Porter (1980) identifies three generic groups of strategy:

1. *Cost Leadership*

This emphasises cost reduction of its products and services. It aims at getting the product or service to the customer at the lowest possible price.

2. *Differentiation*

This approach offers the customer a special value by emphasising quality performance or service. This emphasises the unique or superior nature of a product or service.

3. *Focus*

This concentrates on targeting a selected segment of the market in terms of location, product or groups of customers. A focus can be orientated towards cost or differentiation.

Porter's approach can be summarised by grouping strategies in relation to the product or service in terms of price, quality or segment of the market. In terms of the construction industry, most companies use all three forms of strategy by focusing their business in one or more segments of the market (Group 3) and by competing for work on the basis of price and quality (Groups 1 and 2).

While this approach shows us how an existing strategy is pursued, it does not show us how to choose the market segment, the level of quality to be achieved or the means by which cost leadership can be achieved. Solving these problems requires a more detailed examination of the strategies used by companies to develop competitive advantage. Pierce and Robinson (1991) identify twelve such strategies that they also divide into three groups.

The first group is concerned with the extension or modification of an existing production base:

1. *Concentrated growth* - concentrates on a specific product / market combination
2. *Market development* - the addition of markets to the current base in order to develop the present product or group of products
3. *Product development* - focussing on the modification and improvement of existing products in existing markets
4. *Innovation* - developing new substitutes for existing products.

The second group involves the extension of the present company base by the acquisition of other businesses:

5. *Horizontal integration* - the acquisition of enterprises with the same product line
6. *Vertical integration* - the acquisition of enterprises that manufacture the company's inputs or market its outputs
7. *Opening joint ventures* - joining forces with another company to exploit a new market
8. *Concentric diversification* - acquiring an enterprise which will add strengths and overcome existing weaknesses
9. *Conglomerate diversification* - acquiring an unrelated enterprise.

The third group describes defensive behaviour in unfavourable market conditions:

10. *Retrenchment* - the reduction of the scale of the company's assets and/or activities to improve the current or future market position
11. *Divestiture* - the closure or sale of parts of the company
12. *Liquidation* - the orderly closure of the business.

The application of all twelve of these strategies is readily applicable to Organisational level activity in a construction company. Obviously, strategies 1 to 9, which deal with expansion, are those that will be used by a company attempting growth in a time of change.

At System level there is also merit in consideration of aspects of the Pierce and Robinson (1991) approach. Consider, for example, the materials management system in a construction company, which might become stronger through joint ventures with key suppliers and subcontractors. Existing systems could be adapted and new systems developed to promote innovation and to expand the market base.

### *Strategic Planning*

There are many views on a definition and preferred approach to strategic planning. The following is a summary of the main views.

Armstrong (1993) defines strategic planning as a systematic, analytical approach that reviews the business as a whole in relation to its environment with the aim of:

- developing an integrated, co-ordinated and consistent view of the route the company wishes to follow; and
- facilitating the adaptation of the company to changes in its operating environment.

Lorange and Vancil (1976) state that a strategic planning system is nothing more than a structured process that organises and co-ordinates the activities of the managers who do the planning and that no one system exists as companies vary in size, structure and diversity of operations. However, they agree that the general approach embraces a number of key issues that must be addressed. These are:

1. *Communication of corporate goals*
  - ensuring that everyone is aware of the objectives of the corporate level management
2. *The goal setting process*

- deciding on the goals to be attained in the achievement of the strategy
- 3. *Environmental scanning*
  - an examination of the organisation and the environment in which it operates
- 4. *Subordinate manager's focus*
  - involves the setting of action programmes which will be specific to certain functions
- 5. *The corporate planner's role*
  - the person responsible for corporate change must be influential and be in authority
- 6. *Linkage of planning and budgeting,*
  - corporate planning and corporate budgeting must be linked if only to illustrate on a year to year basis the effect on profitability of effective corporate management.

Churchman et al. (1969) define strategic planning as a planning procedure based on a systems analysis approach and propose a method for strategic planning that comprises four steps:

1. Define the problem by examining the system: its inputs, outputs and decision variables
2. Define the parameters of the system and the constraints on the solution
3. Formulate the object function by defining the efficiency with which inputs are converted into outputs and the dependence of that efficiency on the value of the decision variables
4. The optimal value is obtained by manipulating the values of the decision variables.

Sadler and Robson (1973) define corporate planning as a representation of a systematic attempt to influence the medium and long-term future of the enterprise by:

- defining company objectives
- by appraising those factors within the company and in the environment which will affect the achievement of these objectives
- by establishing comprehensive but flexible plans which will help ensure the objectives will be achieved. This approach is illustrated in Figure 2.1.

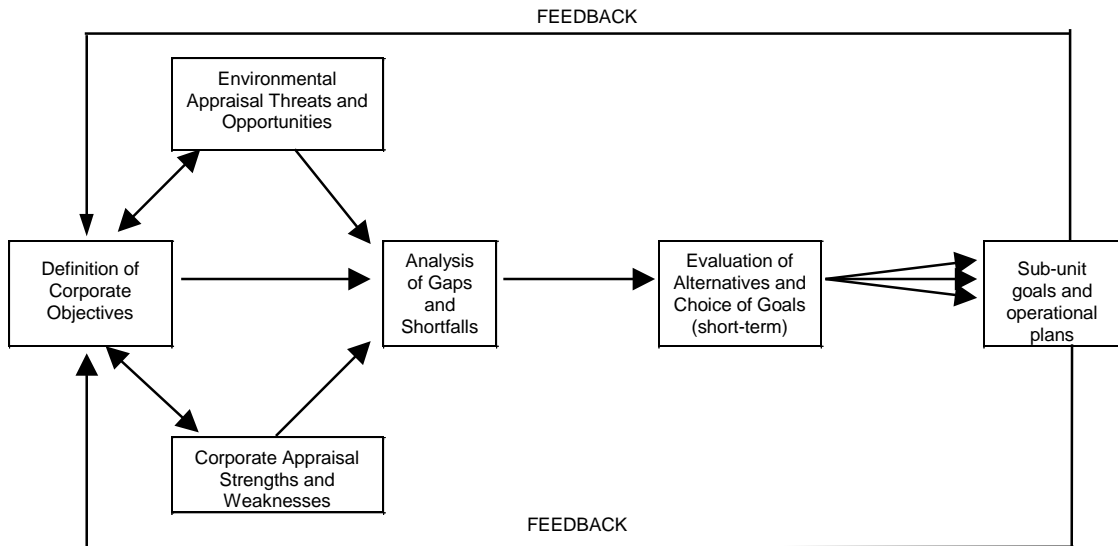


Figure 2.1. Steps in Corporate Planning (Sadler and Robson, 1973)

Armstrong suggests the following steps as a systematic approach to formulating strategic plans:

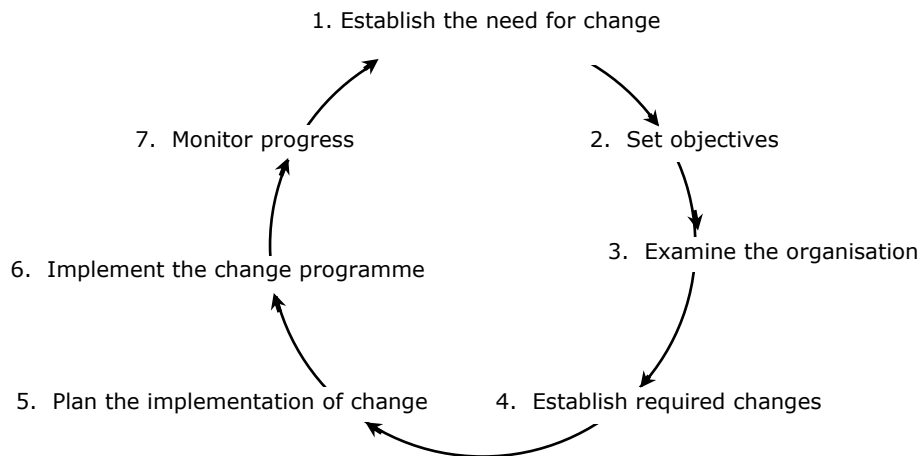
1. Define the company's mission
2. Set objectives to be met in achieving the mission
3. Carry out an analysis of the company's strengths and weaknesses and to evaluate the opportunities and threats that it will encounter (SWOT analysis)
4. Analyse existing strategies and determine their relevance in relation to the objectives
5. Define strategic areas where change must occur
6. Develop new and revised strategies
7. Decide on critical success factors
8. Prepare operational, resource and project plans
9. Implement the plans
10. Monitor results.

All of these approaches to strategic change have a number of common strands that can be summarised using the following broad approach:

1. Define the problem (challenge) and clarify the need for change
2. Determine the preferred outcome and set objectives which must be met in order to reach the preferred outcome

3. Examine the company, its current systems and their strengths / weaknesses, in relation to their ability to meet the objectives
4. Decide where and what changes must be made if the objectives are to be achieved
5. Plan the implementation process to ensure that the changes are accepted by those affected within the company
6. Implement the plan
7. Monitor progress.

This summary of the strategic planning process is illustrated in Figure 2.2. The following section will show how strategic planning could be used in the management of change in Irish construction companies.



*Figure 2.2. Stages in Strategic Planning Process*

*Strategic Planning for Irish Construction Companies*

For Irish Construction Companies, the first step of the strategic planning process will largely depend on the preferred strategy to be applied. The choice of strategy will be greatly influenced by the specific characteristics of each particular company.

Younger (1989) suggests a screening process should be used to judge the appropriateness of a particular strategy to a company. This process should assesses two separate criteria:

1. the attractiveness of the strategy as an investment in its own right, and
2. the extent to which the qualities required for success of the strategy match the company's strengths.

All three of the generic groups of strategy defined by Porter (1980) may be applicable. The first two groups of strategy types as identified by Pierce and Robinson (1991) are also likely to be applicable to a company whose aim is to hold or increase its current market share.

The second stage, the setting of corporate objectives will depend on the needs of the individual company in confronting the challenges it now faces. These challenges were discussed Chapter 1 and arise from changes in EU funding, other European influences, developments in Information Technology, the changing workforce and the pressure on companies to increase competitiveness. The use of Armstrong's (1993) key concepts of distinctive competence, focus and sustainable competitive advantage would be of assistance in identifying the difficulty each of the challenges would pose for the company. Each challenge would be examined and the potential effect on the company assessed. For example, a company may decide to investigate the potential of Public Private Partnership type projects with a view to involvement in such a project within five years. This would lead to further investigation into such matters as the nature of the projects, the risk associated with such a project, and the potential partners required for involvement in such a project.

The third stage involves a detailed examination of the company, how it currently carries out its work and where its strengths / weaknesses lie. During this stage, the examination of the company is very detailed, involving the analysis of its structure, its financial situation, the current age and value of its equipment and assets, its type of work, its current market share, its marketing process, its staff profile, etc. The procedures that it uses in its day to day operation are investigated. Such procedures would include the credit arrangements with its suppliers/subcontractors/bank, staff structure on projects, quality assurance procedures, etc. The strengths and weaknesses within the



company are identified and ranked in importance in the plan for change. Environmental scanning is used to identify the opportunities and threats affecting the company.

In the fourth stage, the company must decide on the changes to be made if the objectives are to be achieved. These changes may be radically different from company to company depending on the level and quality of corporate planning carried out within the company. LaMarsh (1995) states that it is a lack of attention to planning the people related issues in a change programme that most often causes the programme to fail. Deevy (1995) concurs with this view, stating that planning for change must be a consultative process and that imposed change will not have lasting success.

Planning the implementation of the change programme in the fifth stage is carried out in the same way as the planning of a construction project. Once the proposed changes have been agreed, a time scale for implementation of the programme will be established and resources allocated. A draft budget for the change programme is prepared and key target areas for success identified.

In implementation, the sixth stage, it is essential that the most senior level of management in the company is seen by all concerned to be fully committed to the change programme. The responsibility for each aspect of the change programme must be clearly established and each area of implementation must be managed and co-ordinated effectively. Overall responsibility for the programme should be at director level with the full backing of the board of directors.

The seventh stage, the monitoring of progress of the implementation of the change programme must be carried out and reported upon to the board of directors at the intervals set out during the planning stage. Any deviations from the programme must be investigated and corrective action must be taken.

As change is dynamic, the corporate planning process must be continuous and the aims of the programme must constantly be re-examined, updated and actioned as necessary.

#### *Conditions for Successful Strategic Management*

The implementation of change programmes is not always successful and the literature cites several potential factors that can cause failure. Alexander (1985) identified 10 common causes of problems in strategy implementation:

1. Strategy implementation taking longer than expected
2. Major unexpected problems during implementation

3. Distraction of management by other activities or crises resulting in inadequate time to implement the new strategy
4. Poor co-ordination of implementation activities
5. Inadequate capabilities of managers involved in the implementation action
6. Inadequacy of training and instruction given to lower level employees
7. Impact on the plan of events in the outside world
8. Ineffective leadership offered by departmental managers
9. Inadequate identification of key implementation tasks and activities
10. Inadequacy of information systems in the monitoring of performance.

It is of primary importance that these factors are anticipated and recognised in any change programme. All of those in management positions in a situation undergoing change must be alerted to the danger signs and must be in a position to take remedial action. Indeed Hussey (1988) identifies management training as an area that has a major effect on the success of a strategic change programme and suggests 6 situations where training programmes can be used to make a major contribution to strategic management:

1. Strategy formulation
2. Strategy implementation
3. Policy implementation
4. Corporate culture
5. Environmental change
6. Problem solving.

It is in the interface areas between tasks and between processes that the most significant risk of failure occurs. These are the areas where human contact takes place and it is the reaction of the people to the changes in tasks, processes and systems that causes the success or failure of the change. The planning of changes in the interface areas is therefore at least as important as the planning of the changes in the actual levels of activity. This planning must occur in the fourth and fifth stages of the change process (i.e. establishing the required changes and plan the implementation of change). Monitoring of the interfaces through stages six and seven will provide an early warning system for further potential failure.

The nature of the construction industry provides for several interface areas. Typical interfaces in construction occur between:

- operatives engaged in different trades in close proximity to each other
- supervisory staff and operatives
- management and first line supervisory staff
- contractors and subcontractors
- the designers and constructors
- contractor and materials supplier
- site team and head office

All of these areas must be planned for and monitored in any change programme.

#### *Use of the Principles of Strategic Planning at Other Activity Levels*

Strategic Planning techniques are traditionally used in long-term organisation-wide issues but the seven stages of strategic planning could be applied to any change situation. This is illustrated in Figure 2.3, which shows the seven stages adapted to become a generic model for change. This model will be further developed later in this chapter and will be tested in the three case studies later in this thesis.

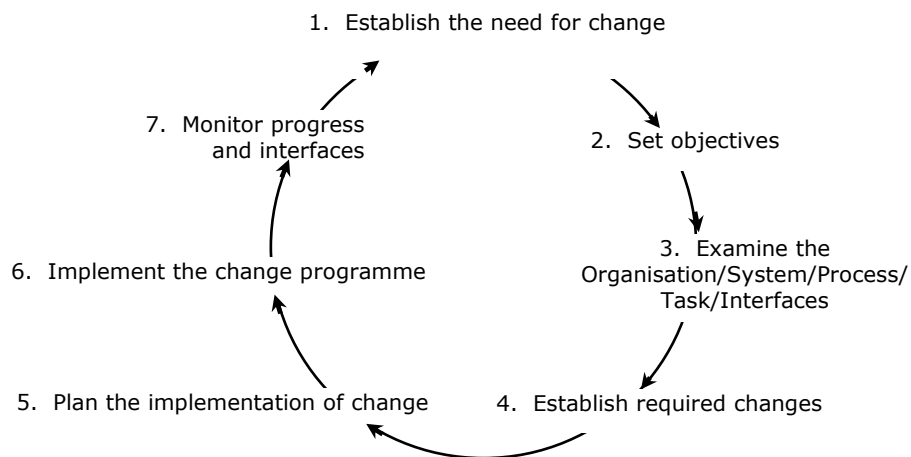


Figure 2.3. *Generic Change Model*

#### *Summary - Strategic Planning & Management*

To summarise, corporate level management of Irish construction companies should use the following guidelines in formulating their strategic plans.

1. Choose a strategy to be followed by the company in relation to the challenges facing the company
2. Set objectives to be met in the achievement of the strategy
3. Carry out a thorough examination of the company's ability to achieve the objectives set and of the environment in which the company operates
4. Decide on the changes to be implemented at each of the activity levels and establish the likely effects in the interface areas
5. Establish a time-scale on and a budget for the implementation process
6. Implement and closely monitor the process
7. Adapt the process as necessary to achieve the objectives.

## 2.3 Re-engineering and Improvement Techniques

### 2.3.1 Introduction

Strategic planning is generally used at Organisational level in the management of long-term change programmes and concerns itself with the company as a whole rather than a specific aspect of the company's operations. We have seen however that the principles used in strategic planning can be applied as a generic model in change programmes at System, Process and Task levels.

Re-engineering and Improvement techniques are often used in change programmes that concentrate on specific tasks and processes within a company. Both techniques can also be used as a part of the application of a strategic plan when such a part relates to a specific area designated for change within the company. Change in System, Process and Task level activities are not normally viewed as being organisation wide and have traditionally been managed through the use of re-engineering and/or improvement techniques.

### 2.3.2 Re-engineering

- also known as Business Process Re-engineering (BPR)

#### *Definitions*

In order to understand BPR, it is necessary to first define the terms "*process*", "*business process*" and "*re-engineering*" in terms of this approach to change.

A *process* is:

"...a structured, measured set of activities designed to produce a specified output for a particular customer or market. It implies a strong emphasis on how work is done within an organisation." (Davenport 1993).

A *business process* is:

"a set of logically related tasks performed to achieve a defined business outcome." Davenport & Short (1990)

In their view *processes* have two important characteristics:

1. They have customers (internal or external)
2. They cross organisational boundaries, i.e., they occur across or between organisational sub-units.

Examples of processes include preparing an estimate; ordering goods from a supplier; compiling a project programme; processing and paying an invoice; etc.

Processes may be defined based on three dimensions (Davenport & Short 1990):

*Activities:* Processes could involve two types of activities:

- Managerial (e.g. develop a roofing programme)
- Operational (e.g. fix slates on a roof)

*Entities:* Processes take place between organisational entities.

They could be:

- inter-organisational (e.g. requiring the co-ordination of suppliers and subcontractors)
- inter-functional (e.g. requiring the input of the designers, the supervisor and the tradesperson)
- inter-personal (e.g. involving the communication of the information between the designer and the supervisor).

*Objects:* Processes result in manipulation of objects. These objects could be:

- physical (e.g. the slates)
- informational (e.g. the nailing requirements of the slates).

Hammer (1990) defines *re-engineering* as:

"...discontinuous thinking...recognising and breaking away from the outdated rules and fundamental assumptions underlying operations. These rules of work design are based on assumptions about technology, people, and organisational goals that no longer hold."

*Business Process Re-engineering* is defined as:

"...the fundamental re-thinking and radical redesign of business processes to achieve dramatic improvements on critical contemporary measures of performance such as cost, quality, service and speed" (Hammer & Champy 1993).

*Business Process Re-design* is defined as:

"...the analysis and design of workflows and processes within and between organisations" (Davenport & Short 1990).

While the terms Business Process Re-engineering and Business Process Re-design are sometimes used to describe the same approach, they are different in that re-engineering refers to a total rethinking of the means by which a process is carried out, while re-design sometimes retains part of the process.

### *Approaches to BPR*

Davenport and Short (1990) recommend a five-step approach to BPR:

1. *Develop the Business Vision and Process Objectives:*

A business vision comprises such process objectives as process simplification, cost reduction, higher efficiency levels, quality improvement, learning, etc.

2. *Identify the Processes to be Re-designed:*

This can take one of two options: either focus on a small number of processes (i.e. the most important processes or those that conflict most with the business vision), or attempt to identify all the processes within an organisation and then prioritise them in order of redesign urgency.

3. *Understand and Measure the Existing Processes:*

This will clarify the strengths and weaknesses of the existing system and provide a baseline from which to measure the effect of redesigning the process.

4. *Identify Information Technology (IT) Levers:*

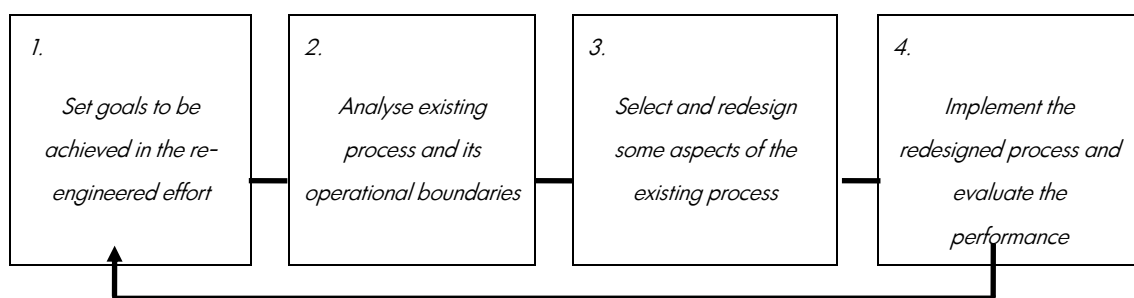
Process change should take IT developments into account.

5. *Design and Build a Prototype of the New Process:*

The actual design should not be viewed as the end of the BPR process; rather, it should be viewed as a prototype, which would be used as a model for further change.

In a model that is closer to re-design than re-engineering, Li (1996) suggests that it is certain aspects of a process that are to be re-engineered rather than the entire process itself and he proposes the model illustrated in Figure 2.4. This model is similar to the generic change model proposed earlier in Figure 2.3 (Page 39). However Li's model concentrates on the process to be re-engineered rather than the managing of the change that would result.

Li also identifies two types of activities that can occur in step 2, namely conversions and flows. Conversions are described as those activities that add value to the process and therefore should be optimised where possible. Flows are non-value-adding activities that should be eliminated or minimised.



*Fig. 2.4. Steps in Process Re-engineering (Heng Li)*

Belts and Wood-Harper (1994) state that there is a need for the application of the principles of BPR to a new research agenda in construction in order to:

- address the high fragmentation, low productivity problems of the industry
- produce efficient interfaces between multiple participants in the construction process in the procurement of products and services
- redesign traditional roles, job tasks and functions
- illustrate the changes to procurement and organisational structures necessitated by the current market moving to alternative contractual arrangements
- document global best practices in innovative inter-enterprise harmony and synergy and to use these examples to suggest others
- find alternatives to standard, worst case task models, such as standard forms of contract and to produce multi-process, non standard models.



While all of the issues raised by Belts and Wood-Harper (1994) are worthy of research and their solution would greatly improve efficiency in the industry, there is little clear evidence that the application of BPR can resolve all of these issues. Indeed Towill (1996) notes that of the thousands of books published on management topics each year, there is a shortage of publications relating BPR to construction. This forces change practitioners in the construction industry to use other sectors such as banking, retail or the automotive industry as examples.

Towill advocates the measurement of effectiveness of organisational systems through benchmarking (the establishment of best practice) at four levels in construction:

- present performance
- best performance of competitors in the industry
- best performance of a given task in the industry
- required future performance.

In concentrating on the time compression of each task, the company's commercial performance should improve through raised productivity, lower wastage rates, higher return on assets and reduced design lead times. Time compression targets should aim at zero waste not only of time but also of materials, labour, capacity, computing power and management effort.

#### *BPR applied to Construction*

One of the few examples of research into the potential use of BPR in construction is the T40 process re-engineering study that was conducted in Australia in 1993/94 (McGeorge and Palmer, 1997). One of the most interesting aspects of that project is that it applied the principles of BPR to the construction processes (in addition to business processes). The objective of this project was to redesign the construction process and produce a new set of practices with a view to reducing construction process times by 40%. The practices produced included:

- Creating a solutions team comprising up to nine organisations (designers, contractors, subcontractors, suppliers)
- Involving all team members in the project design
- Reducing the number work packages to prevent multi-visits to the same construction location by the same specialist
- Having one point accountability to the client
- Introducing financial incentives and penalties for the whole team of nine

- Eliminating rework through getting it right first time
- Using open-book business practices based on trust and fair dealing
- Eliminating traditional tendering
- Pooling of management resources in the solutions team
- Partnering with local government for approvals
- Developing teams comprising management and workforce.

It was the intention of the research group to develop a new approach rather than trying to improve existing practices and this is reflected in the practices proposed. It was recognised that some of the proposed practices would require a significant culture change in order to gain acceptance. However, the research group estimates that a 40% reduction in construction process time would result in a 25% reduction in construction costs. Consequently, the potential gains may be so great that market forces will oblige companies to adopt the measures proposed.

#### *Conditions for Successful Implementation of BPR Programmes*

Deevy (1995) states that 3 out of every four BPR programmes fail and he places the blame for this on the current systems of management within business organisations. These systems are inflexible and consequently fail to address the core processes involved in “...transforming yesterday’s bureaucratic organisation into tomorrow’s responsive enterprise.” Deevy asserts that these inflexible systems exhibit nine factors that are the root cause of a lack of competitiveness in many companies. These factors, which must be addressed by any attempt at re-engineering, are as follows:

1. The management of traditional organisations makes negative assumptions about the attitude of subordinates to work
2. Traditional organisations are not suited to competitive situations as they become bogged down in their own bureaucracy. (This echoes the Hammer & Champy (1993) view that “...America’s business problem is that it is entering the 21<sup>st</sup> century with companies designed during the 19<sup>th</sup> century”.)
3. Traditional businesses often fail to see the need for change - they often fool themselves by convincing themselves that the change is temporary
4. The expectations of workers have changed dramatically
5. Employee loyalty to the business has decreased as insecurity has increased
6. There is an increase in the use of temporary workers

7. Traditional businesses have a reluctance and, in some cases, an inability to adapt to Information Technology
8. There is an inability to respond to increased competition in the market place
9. Traditional businesses promote dependency in the workforce and treat their workers like children.

Deevy argues that an organisation is a living system capable of self-organisation and self-renewal - if the right conditions are created. This living system - if allowed to - is capable of continuously adapting to the needs of the marketplace and to changes in the business environment. Re-engineering the processes should, therefore, be preceded by a major cultural change in the organisation.

Malhotra (1998) agrees that up to 70% of BPR projects fail and he identifies the biggest obstacles to successful re-engineering as:

1. Lack of sustained management commitment and leadership
2. Unrealistic scope and expectations
3. Resistance to change.

He suggests that in addition to tackling these obstacles, the successful implementation of a BPR programme depends on:

- involvement of Human Resources Management - in developing the required change of mindset
- use of Information Technology - in the maximisation of effectiveness and potential of new processes and
- the setting up of pilot areas to iron out implementation problems and to convince participants of the potential success of the programme.

#### *Summary - Business Process Re-engineering*

BPR is used as a drastic measure designed to dramatically alter a process or activity in an organisation. It is often used when the introduction of new technology potentially makes an existing process obsolete. It differs from the generic model illustrated in Figure 2.4 in that it ignores the existing processes and devises totally new tasks and processes. There is a difference of opinion on the success rate of BPR projects with some commentators citing very high failure rates. Aside from

the preliminary results of the T40 Project, there is little evidence of successful application of BPR in construction organisations.

There is however little doubt that in some instances a total re-engineering of a Task, a Process or a System is sometimes required. In such an instance, the use of a Business Process Re-engineering approach should be considered. The following is a set of stages that an organisation would go through when managing change through Business Process Re-engineering:

1. Using the objectives from the strategic plan, decide which processes are to be re-engineered. Remember that this approach is only likely to be used where a radical breakthrough in performance is required. (Rolstadås, 1995)
2. Record the output of the existing process in order to provide a benchmark against which the output of the new process will be compared
3. Develop the new process concentrating on time compression, having first gained the input of the individuals who will use the process and having identified the potential use of IT in the new process
4. Set up the process on a pilot basis to eradicate problems and to reinforce the belief of the operators in the superiority of the new process
5. Monitor and improve the process as necessary.

### 2.3.3 Improvement and Quality Management

If a task, process, or system is already working well then it is best to seek further improvements in the activity rather than re-engineer the activity. There are many suggestion methods for achieving improvement and the remainder of this chapter examines the more prominent methods.

#### 2.3.3.1 Continuous Improvement

Harrison et al (1997), while analysing BPR, introduce the concept of “continuous improvement” which they define as

“...finding the next step beyond the world of *doing things the way we’ve always done them.*”

This concept is illustrated in Figure 2.5.

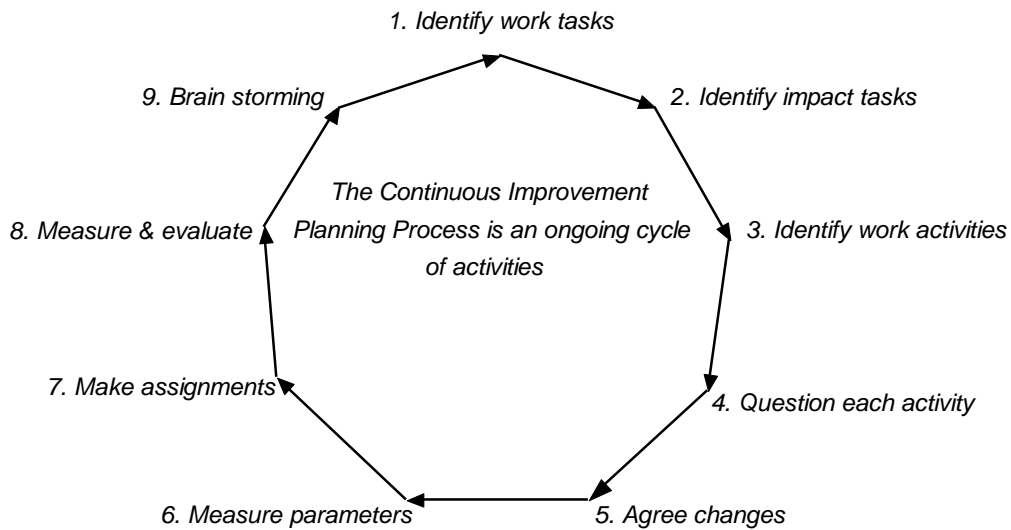


Fig. 2.5 The Continuous Improvement Planning Cycle (Harrison, et al. 1997)

This concept is similar to Li’s approach to BPR (Figure 2.4, Page 44), but differs in that:

- it questions the effectiveness of tasks and affects re-engineering only if the task is no longer effective
- the search for effectiveness is continuous.

The stages of the concept are further developed as follows:

1. *Identify work tasks*

Identify all the tasks to be carried out in order to get a job done, sub-dividing where necessary

2. *Identify impact tasks*

Identify the tasks that have the greatest impact on cost, quality or scheduled

3. *Identify work activities*

Identify the work activities associated with the impact tasks

4. *Question each activity*

Ask such questions as

- Why do we do that?
- What value does it add?
- How does it increase quality?
- Can we do it more effectively?
- Can we limit part or all of it?
- Can we improve quality and/or reduce the cost of the activity?

5. *Agree changes*

Reach consensus on the changes to be made and on how to implement such changes

6. *Measure parameters*

Measure what is being done now for use as a baseline from which the benefits of continuous improvement can be measured

7. *Make assignments*

Assign the development of concepts and ideas to members of the group. Each assignment must include a specific work product and a schedule for completion

8. *Measure and evaluate*

Sharpen the ability of management to objectively evaluate the impact of employment changes

9. *Brain storming*

These meetings are used to produce new ideas for improvement.

Harrison et al. identify the keys to success in the implementation of a continuous improvement strategy as follows:

- brainstorming meetings must be tightly controlled if they are to be productive
- everybody in the organisation must see the need for change
- agreed changes must be implemented quickly
- success must be documented and communicated to all those involved in the change
- all facets of work processes must be scrutinised for potential improvement areas.

This approach is highly task-orientated and appears to take little cognisance of the interface areas between tasks. It is likely, therefore, that change management using this approach would require further action involving an approach that would address the interface areas. The key to successful implementation in the interface areas involves looking at each participant's contribution to a process and at the effect of this contribution on the preceding and succeeding participants. Such an approach is found in Total Quality Management (TQM), which portrays every participant in a process as a customer of the previous participant. TQM is discussed in detail in the following sub-section.

### 2.3.3.2 Quality Management

Flood (1993) defines quality as *“...meeting customers’ (agreed) requirements, formal and informal, at lowest cost, first time every time.”*

Total quality *“...means that everyone should be involved, at all levels and across all functions, ensuring that quality is achieved according to the requirements in everything they do.”*

The principle of continuous improvement is also central to Total Quality Management (TQM). TQM was developed out of the quality movement pioneered by Deming (1966, 1982 & 1986) and Juran (1964, 1980, 1982 & 1988) and Crosby (1979, 1981, 1984) among others. Both Deming and Juran applied their quality theories to maximum effect in post World War 2 Japan.

Japan had gained a reputation for producing a poor standard of goods that were notorious for breaking down. Following the war, many top industrialists were removed from their positions and replaced by individuals from operational areas. These individuals brought with them a new approach that concentrated on reducing defects in manufactured products. This led them to the area of quality control and they enlisted the assistance of a number of experts in the field, including Deming and Juran, from the United States.

Deming had developed a technique called Statistical Process Control which was used to identify causes of variability in manufacturing output. He also developed a systemic approach to problem solving, as illustrated in Figure 2.6, called the PDCA cycle (i.e. *plan, do, check, and carry out action*).

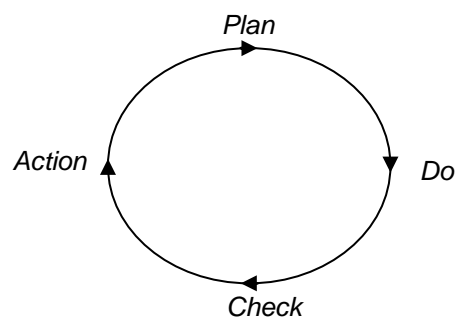


Figure 2.6. Deming's PDCA Cycle

Deming's work included the development of consumer research and extensive writings on the need for change in American management's approach to motivation, leadership and training. He identified five causes of inefficiency in American industry called the "five deadly diseases".



They were:

1. A lack of constancy and purpose
2. Too much emphasis on short-term profit
3. Inefficient evaluation of performance
4. Management was too mobile
5. Too much reliance on quantitative data in the decision process and not enough consideration for less tangible or hidden factors.

Deming produced an action plan to tackle these “diseases” concentrating on:

- management taking responsibility for and leadership of change
- promotion of teamwork
- reduction in inspection in the achievement of quality
- awarding business on total cost rather than on price
- creation of a culture of pride in one’s work
- increased communication
- institution of vigorous education, training and self-development programmes.

Juran (1988) emphasised the importance of top and middle management involvement in quality planning, quality control and quality improvement. His philosophy centred on the customer, the customer being anyone to whom we are providing a product or service. The customer can be either internal or external and often differs from the consumer. His “quality-planning road map” points to nine issues that must be addressed in dealing with customers:

1. Identify the customers
2. Determine their needs
3. Understand these needs
4. Develop a product or service which will respond to these needs
5. Optimise the product or service to help meet the producer’s needs as well as those of the customer

6. Develop a process to produce the product or service
7. Optimise the process
8. Prove that the process can produce the product or service under operating conditions
9. Transfer the process to operations.

The concept of the interface areas between tasks, processes and systems draws on the approach of Juran in that it looks at the interaction of those performing the task/process in addition to the activity in the task itself.

Crosby's TQM philosophy is based on his five absolutes of quality management:

1. Quality is defined as conformance to requirements, not as 'goodness' or 'elegance'
2. There is no such thing as a quality problem (i.e., quality does not create problems, it is the management of the process than causes problems)
3. It is always cheaper to do it right first time
4. The only performance measurement is the cost of quality
5. The only performance standard is zero defects.

Crosby advocates a 14-point programme for quality improvement that he supports with a number of tools to help achieve the steps in the process. The main tools are:

- the "Quality Maturity Grid" (a means for management to measure their progress as a quality company)
- the "Make Certain Programme" (an on-going examination of methods by the people involved in order to aid defect prevention)
- the "Management Style Evaluation" (self evaluation of managers under a number of headings)
- the "Quality Vaccine" (a procedure for eliminating non-conformance).

From the work of Deming, Juran and Crosby, the main principles of TQM can be summarised as follows:

1. Everyone involved in a process is the customer of the person carrying out the previous task

2. Everyone in the process is constantly examining their actions in order to give a better service to their customers
3. Everyone involved in the process is responsible for his or her own task(s).

Total Quality Management therefore places the management responsibility of each task with the individual carrying out the task and with all others who affect the outcome of the task. As the interface area of activity is dependent on the effect of the action of one person on the task being carried out by another, the principles of TQM can be readily applied to the interface areas.

### *Application of TQM in the Construction Industry*

Arditi and Gunaydin (1997) reviewed the status of TQM in the construction industry in the USA. Using the results of a survey of 143 construction managers, designers, contractors and facility managers, they investigated the use of TQM in the design construction and operation phases of projects undertaken in the USA. This information was used to establish a chain of supplier customer relationships as illustrated by Figure 2.7.

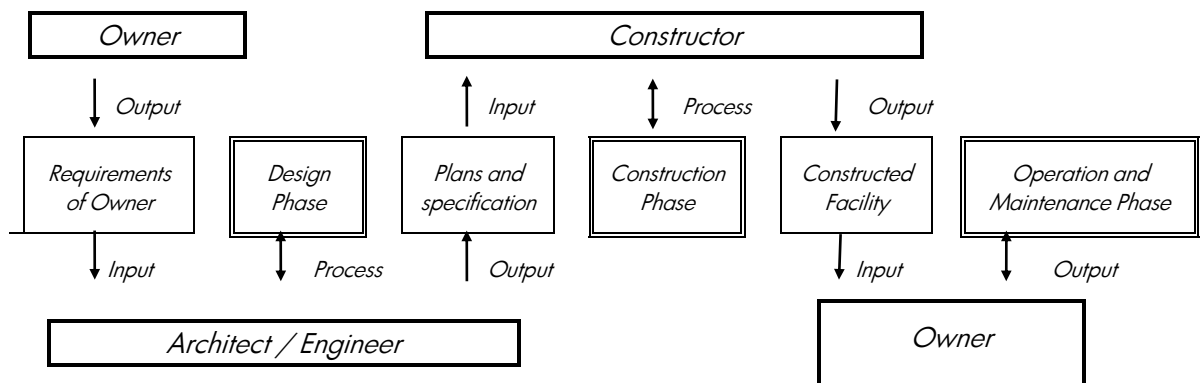


Figure 2.7 Supplier / Customer relationships in the Construction Process (Arditi and Gunaydin, 1997)

Arising from the views expressed in the survey, quality was defined as:

*"... meeting the requirements of the designer, constructor and the regulatory agencies as well as the owner."*

This study showed that the construction organisations in the USA were more inward looking and were managed more by control than by participation. Such organisations would find it difficult to embrace the principle of looking at the needs of the customer first rather than concentrating on the internal needs of the company. This inward looking attitude by management makes American companies wary of training the typical transient construction workforce in the principles of TQM, as they fear that the fruits of their training efforts will be borne by other organisations. This reflects the situation in Ireland as noted in Chapter 1. It is a problem which Ardit and Gunaydin see as one that is diminishing, as the use of TQM becomes more widespread.

Arditi and Gunaydin commented on the U.S General Accounting Office who have examined the area of quality costs and have produced figures based on the performance of 20 companies who have implemented TQM. Significant percentage improvements are recorded in reliability, customer satisfaction, market share and turnover. While high costs of implementation are recorded, the return to both the client and the contractor far exceeds these costs, in one case by 495%. In relation to the supplier / contractor relationship, Ardit and Gunaydin found that the more successful the TQM implementation, the more likely this relationship would develop into a long-term agreement. This has obvious advantages as it moves towards a teamwork approach and away from an adversarial approach.

Arditi and Gunaydin noted that transfer of knowledge of TQM implementation in the construction industry, must take the differences between manufacturing and construction industries into account. The following construction industry specific factors were identified:

- construction consists of one-off projects
- each project has a fixed site
- the production cycle is very long
- quality is evaluated subjectively as these projects are generally all prototypes
- the customer (i.e. owner of the building) directly influences production
- there are different participants on each project.

The following trends were also evident from the research:

- quality is designed into and evaluated for each project individually
- quality control procedures in use are generally retrospective, in that they are used more to seek out and repair defects rather than to prevent them
- due to the one-off nature of projects, learning is not transferred effectively from project to project.

The Total Quality Management Task Force (TQMTF) of the Construction Industry Institute (1993) describes TQM as “...a journey, not a destination” and uses the journey metaphor to produce the “TQM Implementation Roadmap”, which is attached as Appendix 2. The journey is divided into 4 stages:

1. Exploration and commitment

2. Planning and preparation
3. Implementation
4. Sustaining.

The Construction Industry Institute compiled the Roadmap in recognition of the need for a comprehensive set of TQM implementation guidelines for the construction industry. The route taken to implementation was prepared based on data gathered from the experience of 17 organisations who had implemented - or were in the process of implementing - TQM at the time the report was compiled. The average time taken to achieve completion of the first three phases of the Roadmap was 5.5 years. However this took into account many mistakes which were due to the lack of knowledge of TQM at the outset. It is suggested that the completion of the first three phases should now take approximately three years.

For successful implementation, the Task Force stated that the management of a company must:

- Know *why* it is considering implementing TQM in the organisation
- Know, and formally state, its expectations for TQM implementation
- Know what TQM will require of the organisation
- Be willing to undergo cultural and behavioural change
  - in the organisation
  - in themselves.

The following management actions would then be required in successful implementation:

- Carefully plan and structure the entire TQM implementation process. Consciously choose which strategic approach makes the most sense for the organisation
- Get competent help from external quality consultants. Do not try to go it alone
- Let the reward system make the point of the importance of the TQM and team processes
- Deploy TQM company-wide only after proper planning, preparation, training, and pilot applications
- Commit to ongoing organisational as well as personal learning
- Be patient, yet persistent.

Baxendale and Burrell (1997) interviewed 12 U.K. construction companies to find:

1. Aims of companies' TQM initiatives
2. Cultural change and management commitment related to the success of TQM
3. Problems encountered with TQM in construction
4. Benefits reaped from TQM
5. Reservations and opinions regarding TQM
6. Relevance of BS 7850

Their findings were as follows:

1. The aims of the companies embarking on the TQM process were:

- to improve operating efficiency through the utilisation of continuous improvement
- to achieve cost reductions and to increase profits
- to enhance job satisfaction within the workforce
- to increase staff involvement
- to gain better understanding of customers, both internally and externally

(The overall objective was to improve demand for their services, whilst remaining competitive).

2. In relation to cultural change and management commitment, the following observations were made:

- cultural change was seen as important
- management commitment was seen as imperative
- success was seen as totally dependent on acceptance of change
- sensitivity was needed to carry out the change

(One company felt that cultural change was not required as the existing culture of the company had led to its success to date).

3. The following problems encountered were highlighted:

- changes in projects and personnel
- depressed state of their industry leading to job uncertainty

- day to day problems overshadowed TQM strategies.
4. All companies recorded that TQM implementation was beneficial in the following areas:
- procedures and internal communication improvements
  - employees changing roles and responsibilities were redefined
  - improved customer relations through increased understanding of needs
  - increases in profitability, cost control and perception (some companies reported no change in these three items).
5. Reservations about the process centred on the following:
- TQM was sometimes seen as too difficult to implement
  - focus at site level was on immediate problems and the wider view was difficult to establish.
6. When asked to comment on the relevance of BS 7850 to their TQM system the following points were made:
- BS 7850 was seen as pertinent to the process of change
  - it aided the examination of activities and customers
  - it was of assistance in making necessary changes
  - three companies had not used BS 7850.

Baxendale and Burrell drew the following conclusions from their research in relation to TQM implementation:

- goals must be clear and tasks must be manageable
- TQM must be integrated into the management structure
- TQM programmes must be adapted to suit the company's characteristics
- commitment is vital to success, particularly at management level
- cultural change to institute awareness of quality is critical



- "right first time" attitude must replace "fix it" attitude
- internal matters must be resolved before undertaking external partnerships
- staff/customer surveys should be used to measure improvements. Use criticism constructively
- use benchmarking to assess progress towards excellence.

They made the following recommendations

1. Implementation of TQM only for certification is not enough; the focus must be shifted onto the company
2. TQM standards (including BS 7850) need to be reworked to suit the construction industry, as they are currently more suited to manufacturing industry
3. The development of a quality improvement culture and of partnerships between contractors, suppliers, consultants and clients needs to be encouraged.

In relation to the implementation of quality programmes in Singapore, Low and Chan (1997) claimed that the Quality Manager and his/her level of authority were critical to the success of the implementation. The following points were made:

- the quality manager must have full authority as well as responsibility for the quality management system
- quality managers tend to be chosen based on the number of years service with the company, their educational level, the position held within the company, and leadership qualities
- the leadership style of quality managers should include:
  - an ability to establish clear goals
  - asking for suggestions and taking feedback seriously
  - expressing genuine appreciation and enthusiasm
  - a willingness to share ideas
- quality managers must use the power necessary to do the job, but should avoid the use of coercive power if at all possible. Rewards can be used to motivate employees
- the quality manager must constantly encourage employees to develop a good attitude to quality and to participate in the development of the quality system

- top management must be fully supportive of the quality system and should foster open communication and feedback.

### *TQM Implementation Problems*

Watson (1997) summarised the problematic issues associated with TQM implementation:

1. Insufficient commitment from senior management
2. No formal implementation strategy. TQM is a project and should be planned as such
3. Lack of effective communication
4. Narrowly based training. Training is required in all of the skills needed for TQM implementation
5. Lack of concentration on existing strengths of company. Watson recommends that a Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis or Political, Legal, Economic, Social, Cultural and Technological (PEST) analysis be carried out.

Watson concluded that the key elements for success in implementing TQM are:

- Senior management must fully understand the philosophy and requirements of TQM
- A common vision of the process must be maintained across the whole organisation.
- Adequate resources must be provided
- Implementation strategies must be developed based on an incremental process
- Procedural systems must be designed pertaining to work practices.

These elements reflect the findings of Malhorta (1998) in relation to successful BPR implementation. This suggests that the success of any change project, regardless of the approach taken, will be dependent on:

- Senior management support
- Common vision communicated to all in the organisation
- Involvement of workers in changing tasks, processes, systems and interfaces
- Use of pilot schemes to promote incremental success.

### *Summary - Total Quality Management*

In summary, the TQM is defined as a system in which the whole company is involved in meeting the needs of the company's customers, both internal and external. It is based on the following principles:

1. Everyone in the construction process is, at any one time, a supplier or a customer
2. Defective work is unacceptable and all of those involved in any aspect of the company's work must continually endeavour to eliminate defects
3. Changing circumstances are seen as an opportunity to gain competitive advantage rather than as a threat to the company
4. Cultural change is expected of the company and of those working in the company.

The following elements are essential if the implementation of TQM is to be successful:

1. Total commitment to the process is vital, particularly by top management
2. The implementation process must be carefully planned using key identifiable milestones to measure progress
3. TQM must be integrated into the management structure so that it becomes a part of what the company is, rather than something the company does
4. Communication across the entire company, at any level, must be unrestricted.

### 2.3.3.3 Value Engineering

The search for improvement is also present in the concept of Value Engineering (also known as the Value Method, Value Analysis or Value Management).

SAMI (1998) state that the true value of an activity or product is its relationship to its perceived worth as opposed to its life-cycle costs. In Value Method terms:  $\text{Value} = \text{Worth} / \text{Cost}$ . When an item has a Value greater than 1.0, it is perceived to be fair or good value; when an item has a Value less than 1.0, it is perceived to be poor or bad value.

Martin (1997) outlines the use of Value Engineering where a company uses a “job plan” to examine its current work processes through the following stages:

1. Selection
  - selection of the process to be analysed
2. Information
  - definition of the function of the process
  - mapping of the process
  - establishment of the cost and worth of each part of the process
3. Creativity
  - suggestion of alternatives
4. Analysis
  - evaluation of alternatives in relation to the purpose of the procedure being carried out
  - choice of the preferred alternative
5. Development
  - development of the new process establishing changes in design, cost implications, viability and benefits
6. Presentation
  - documentation of the new process

- training of operators in the new process, providing further clarification or information as necessary
7. Implementation
    - implementation of the new process
  8. Verification
    - compilation of feedback
    - improvement / refinement of the process as necessary

Value Engineering is used widely in the United States, where there is a specific Federal Acquisition Standard (Department of Defense, 1999), relating its use.

Standard No. 52.248 - 3: Value Engineering - Construction includes the following sub-clause:

*“The Contractor is encouraged to develop, prepare, and submit value engineering change proposals (VECPs) voluntarily. The Contractor shall share in any instant contract savings realized from accepted VECPs...”*

Kinnan and Martin (1997) note that the Value Method has been used by many American Government agencies since the 1960s and that cost reductions have increased as these programmes have matured. They further state that experience in the U.S. has shown that the value of improvement will generally exceed the cost of producing the improvement on projects where construction costs exceed \$500,000.

Kinnan and Martin state that there are many misconceptions about the Value Method. It is a decision making process which requires the performance of a series of procedures in a specific sequence. It is not, they state, something that is used to fix mistakes.

#### *Value Engineering applied to the Construction Process*

There are several documented accounts of Value Engineering being applied to the construction process, all of which point to the resultant significant savings. Value Engineering can also be applied to other processes, again with significant results. The following are some of the accounts of application of Value Engineering.

Curtis (1993) gives details of Value Engineering (VE) applied to a section of the Boston Harbour Project. The section was originally valued in excess of \$31 million. A Value Engineering study,

conducted on the design of twin conduits for a force main in a large waste water plant, recommended changing from open cut construction process to tunnels. This change resulted in a reduction of construction costs to \$22 million, a saving of 36%. Curtis emphasises that this saving was only made possible by the application of Value Engineering in the design phase.

Meng (1994) describes a Value Analysis case study conducted on the construction document production process. The purpose of this study was to show that while VE usually concentrates on what is designed, it is also worth examining how design is conducted. The production of the documents in question was estimated originally to take 1,832 man-hours. The Value Analysis revealed that this could be reduced to 1,243 man-hours, resulting in a cost saving of \$40,000. The production of the Value Analysis cost \$8,000 leaving a net saving of \$32,000 or approximately 25% of the originally estimated cost of the process.

Sasaki (1994) applies the principles of VE to construction project planning. The job plan proposed consists of 10 steps beginning with the gathering of information, proceeding through definition and analysis of functions, and ending with a techno-economic evaluation of the methods considered. Those methods giving highest value and which the company has the technical expertise to carry out are prioritised. This approach should prevent waste of time and cost arising from poor planning. It should also reduce "post construction" repairs.

Locke and Randall (1994) give an account of the application of VE to the development of the Ludgate Project in the City of London from 1988 to 1992 and show that it accounted for a reduction in costs of 15% on the project.

Locke and Randall state that Value Engineering succeeds in construction as costs are too high due to the nature of the design process and the traditional roles of the participants in the process. They claim that these factors are contributed to by all of the participants in the construction design process. Clients give insufficiently detailed design briefs. Architects interpret the client's brief according to their own design parameters without initial input from structural engineers, services engineers and constructors. Structural Engineers want maximum factors of safety often at the expense of aesthetics. Services Engineers want maximum service zones and plant areas with large factors of safety. The application of Value Engineering can reduce costs by addressing the following issues:

- Designers working in isolation

- Core construction skills omitted from the design process
- Poor briefing of designers
- No onus on designers to investigate alternative construction solutions

The less adversarial types of contract arrangement, for example, Construction Management, Management Contracting and Design & Build, all help to some degree in facing this problem.

The opportunity to improve the value of a project is greatest at project inception as shown by Figure 2.8. This shows that, in order to maximise savings, Value Engineering should commence at the earliest opportunity in the development of the design brief. It can continue up to and including the procurement of Trade Contractors.

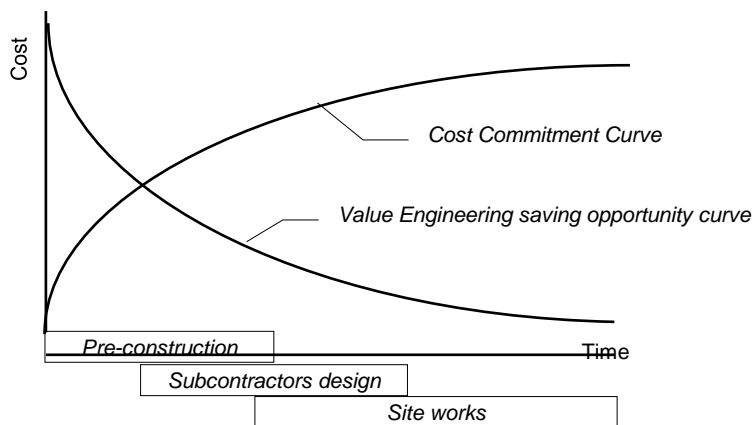


Figure 2.8. *Value Engineering Saving opportunity vs. Cost Commitment (Locke & Randell, 1994)*

While most of the available literature points to specific projects that have benefited from the application of VE, Hannan (1994) proposes the use of a workbook to standardise the approach to Value Management on construction projects and thereby open the use of the process to the entire industry.

Towill (1998) introduces the concept of Business Systems Engineering which is the application of engineering techniques to business processes. With this technique, the company attempts to reduce the Total Cycle Time (i.e. the time interval between expression of interest by the customer

through to the satisfactory delivery of a product/ service/building to the customer). When analysing waste of time, activities within each business process are classified into three types:

- those which are composed of Value Added Time during which the product is enhanced in value
- those which have Non Value Added Time which is still essential to the process (e.g. safety/quality audits)
- those with Non Value Added Time which is wholly waste and contributes nothing to the process, safety or quality.



Business Systems Engineering attempts to identify and eliminate all unnecessary Non-Value-Added time. Typical causes of waste time on site are identified as:

Rework due to drawing changes	40%
Rework due to the job being done incorrectly	35%
Inefficient work methods	15%
Wasting time due to defective materials	5%
Changing customer requirements	5%
All other sources	5%

Towill suggests that application of the Pareto Principle (80% of problems are caused by 20% of activities) should influence the targeting of our efforts to specific areas. Productivity increases of 20% to 35% are recorded by Towill in the application of Business Systems Engineering to various construction projects.

#### *Summary - Value Management*

Value Engineering is the application of a systemised process in the search for cost reduction. Documented success of this technique to date suggests that it is best used when applied early in the design process. This may be of value to companies contemplating a move towards PPP type projects. There is also evidence that this process can have benefit when applied to a specific procedure within an organisation, and consequently may be of use when examining existing technologically based tasks in the construction process, as well as management tasks.

## 2.4 Conclusion

There are many ways to approach change and the technique used will depend on the type of challenge that the organisation is facing.

Strategic Planning is whole organisation approach used in facing a challenge that will potentially alter the corporate direction of the organisation.

Process re-engineering is used to achieve drastic improvement in the efficiency of part of an organisation and is often used when new technology potentially makes an existing process obsolete.

The Total Quality Management (TQM) approach takes the view that in the performance of every task, an individual is either a supplier or a customer of a product or service. The interface areas between activities would benefit most from the TQM approach to change.

Value Engineering has produced its best results to date when applied as early in the design process as possible and consequently is generally viewed as a project specific application. However, there is evidence to suggest that it can be applied successfully in process improvement and consequently this approach should be considered in such situations.

There is therefore, no single approach that can be used at all activity levels, at all interface areas and in all circumstances to guide the process of change in a construction organisation. Table 2.1 illustrates the suitability of the approaches to the different activity levels and shows that those planning change must use a number of different approaches if the change is to be successful.

### 2.1 Change techniques related to levels of activity in the industry

	Strategic Approach	Business Process Re-engineering	Total Quality Management	Value Engineering
Industry	4			
Interface	4			
Organisation	4	4		
Interface			4	
System	4	4	4	4
Interface			4	
Process		4	4	4
Interface			4	
Task		4	4	4

Whatever approaches are used, their success depends on the following factors:

1. The change must be fully thought out and meticulously planned
2. The highest level of management within the organisation must fully understand and be totally committed to the change process. As Drucker (1954) points out, the major obstacle to organisational growth is managers' inability to change their attitudes and behaviour as rapidly as their organisations require
3. Lines of communication must be opened and maintained across as many levels as possible within the company
4. Training in all aspects of the new systems and all in all of the skills required by the new systems must be given to all of those involved
5. Change is dynamic; therefore the change process itself must adapt to suit any new circumstances in which their organisation finds itself.
6. Once the change programme has been implemented, the process of change must continue if competitive advantage is to be maintained.

While no single approach will be adequately guide change in all circumstances, the principles of Strategic Planning can also be applied as a Generic Change Model (Figure 2.3, Page 39) to establish the stages through which any change project will go. This model will be applied to and tested in the case studies in section 2 of this thesis. The following is a summary of each of the stages of the model.

*1. Establish the need for change*

In all situations a reason for the change must be established. Without this, it will not always be possible to develop senior management commitment to the change.

*2. Set the objectives*

Once the senior management is committed to change, the preferred outcome is established. It then becomes necessary to establish specific objectives for the change programme against which the progress of the programme will be monitored. Consequently it is necessary, at this

stage, to design the monitoring process. These objectives will also establish the activity level(s) on which the change will focus.

*3. Examine the existing structures*

This stage involves a detailed analysis of the existing structures within the organisation at the level(s) where the change will be focussed.

*4. Establish the required changes*

It is now necessary to decide what is to be changed. In this stage, the approach to change is decided upon. If a drastic improvement is required, then BPR may be the correct approach; if incremental improvement is required, then VE or TQM may be more appropriate. The change in the activity at each affected level then is established.

*5. Plan the implementation*

While stage 4 established what would be changed, this stage establishes how the change will be implemented. The interfaces between the participants in the changed system or process activities are established and analysed. An appropriate approach to dealing with each interface is also established. A schedule for implementation is devised.

*6. Implement the change programme*

Stages 4 and 5 will have established what to change and how it is to be changed. This is now put into place and early problems are addressed immediately in order to remove obstacles to the change

*7. Monitor the progress of the change and the reactions at the interface areas*

Once the change programme is in the implementation phase, it is essential to ensure that it is working. Its progress will now be monitored as set out in stage 2. The interface areas will present the greatest challenge, as the reactions of individuals to changing circumstances are not always predictable. Problems must be addressed as early as possible in order to minimise disruption to the change programme. To a certain extent, change is like a moving target. In order to achieve success, we must continually refocus our efforts to keep the objectives of the programme in our sights.

## SECTION 2

### CASE STUDIES IN MANAGEMENT OF CHANGE IN THE IRISH CONSTRUCTION INDUSTRY

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This section recounts three case studies, in each of which a change was proposed in a construction company. The changes centre on aspects of the management of labour, plant and materials.

Chapter 3 recounts a case study that examines materials management in an Irish construction company. The company (Company A) is a medium sized developer/contractor working in the residential sector. Its turnover in 1997 was approximately £50 million. It specialises in apartment building in the mid-to-upper price range. The systems used to control the construction activities and administration of Company A are finely tuned as the product being constructed varies little from project to project. Most of the buildings are designed under the control of Company A, leading to a high level of standardisation across projects. This in turn leads to a high percentage of sub-contracted work being carried out by the same companies from project to project and to a high percentage of materials being consistently purchased from a small number of regular suppliers. Company A was approached with a view to reviewing an aspect of its materials control, in an exercise to establish where improvements (if any) could be found. An approach to the implementation of proposed changes was also to be established.

In Chapter 4, the subject of plant management is explored through Company B. This company operates in the maintenance and small new build sector. It has a wide client base, from householders to health boards and had 70 projects active at the time of the study. The company turnover in 1997 was approximately £10 million and it directly employs up to 100 people at any one time. A small number of subcontractors is also used. The management of Company B has recognised that efficiency could be improved in the management of its plant. The case study examines the methods used to control plant, outlines areas of weakness in the system and proposes a range of possible actions that could increase efficiency. The principles of change management that apply to these proposals are discussed and the pitfalls that could be encountered identified.

Chapter 5 provides the most comprehensive of the three case studies. It introduces a third company (Company C) which operates mainly in the commercial/industrial sector and is one of the largest construction companies in the country. Company C has made a previous attempt to implement a structured training programme for its younger engineers and quantity surveyors. This programme showed the classic signs of well-meaning initiatives that have failed. The programme was designed in great detail, it was fully supported by top management, it was set up and implemented with a great deal of enthusiasm and yet it failed within a period of two years. Company C now requires two things: an examination of the previous programmes to establish the

cause of their failure, and secondly; the development and implementation of a new programme which will provide the training necessary to satisfy the construction management needs of the company well into the next century.

## Chapter 3

### Case Study 1

#### Analysis of the Efficiency of a Construction Company's Material Supply System

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### 3.1 Introduction

It is generally accepted that the cost of materials accounts for approximately 50% of all construction costs. Research in Finland (Wegelius-Lehtonen, 1995) has shown that the cost of handling materials in turn accounts for approximately 25% of construction costs. Clearly the purchase and control of materials is therefore worthy of study in the search for greater effectiveness and efficiency. Once the route for savings is found, the company must then establish a means by which it can change from using its current processes to using the more efficient and effective processes. Wegelius-Lehtonen research applied supply chain management principles to the materials management system in a construction company. This chapter documents an attempted replication of Wegelius-Lehtonen's approach to locating and removing inefficiency in a materials system of an Irish construction company.

A company with well established procedures is deliberately chosen in order to illustrate the possibilities for change in even the most organised company. The first four stages of the Generic Change Model proposed in the previous chapter are followed in order to guide the change process. The study looks at both the materials handling process and the administrative process and concludes that substantial savings are possible. The implications of the findings for the industry at large are then discussed. The chapter concludes with a summary of the changes proposed to the methods that we use to buy and handle construction materials.

### 3.2 Background

Company A is a medium sized developer/contractor working in the residential sector. Its turnover in 1997 was approximately £50 million. It specialises in apartment building in the mid-to-upper price range.

A typical project is built on land owned by the company. Company A acts as the developer, organising the design of the building and applying for planning permission. On receipt of permission, Company A proceeds to construct the building and also acts as the agent for sales or leasing as appropriate. This all-inclusive role leads to a high level of standardisation across projects and little or no disruption of the construction phase arising from design problems. Most of the work is subcontracted, using the same subcontractors from project to project. A high percentage of materials are consistently purchased from a small number of regular suppliers.

Company A is a family owned and managed organisation with a small number of large projects in progress at any one time. Family members act as Contract Managers to control each of the projects. A small core of front line management, supervisory and administrative staff are employed to take responsibility for the day to day running of the projects, the supervision of the work, the purchasing of materials and the general administration of the business. The owners retain control of all key management activities.

The systems used to control the construction activities and administration of Company A are finely tuned as the product being constructed varies little from project to project and there is a very low staff turnover. Company A was approached with a view to reviewing an aspect of its materials' handling process. Using the Generic Change Model, the stages to be followed were:

1. *Establish the need for change*

In this study the challenge was to establish where improvements (if any) could be found in the materials management system

2. *Set the objectives*

These are set out in sub-section 3.3.

3. *Examine the existing processes*

This is addressed in sub-sections 3.6, 3.7, and 3.11.

4. *Establish the required changes*

This is addressed in sub-sections 3.8 and 3.12.

### 3.3 Objectives of the Study

In order to use a material from which comparisons could be drawn with existing research, it was decided to study the delivery and handling of timber to Company A's construction sites. Direct comparisons could then be drawn with Wegelius-Lehtonen (1995).

The objectives of the study were as follows:

1. Identification of the process involved in bringing timber to the work face
2. Establishment of the percentage cost added to the timber by the materials handling process and the administration of the purchasing system
3. Analysis of options for increasing the effectiveness and efficiency of both the materials handling process and the administration system, thereby reducing the percentage added cost of the timber

As the scope of this study does not include implementation of the proposed change, the success of the study would be judged on the level of potential savings found.

### 3.4 Design of the Study

To achieve these objectives the following procedure was established:

1. Observe four deliveries of timber, noting each task and the duration of each task in the process
2. Establish a cost for each task and from this, estimate the additional percentage handling cost in each delivery
3. Record the lowest, average and highest cost of each task and compare this with the actual cost in each delivery
4. Examine the tasks that consistently exhibit the greatest cost and suggest means by which this cost could be reduced.

The type of timber chosen was white deal in lengths 2.4m, 72mm width and 35mm thickness. It was delivered in bales of 300 lengths.

It was also decided to examine the costs arising from the administration of ordering and paying for goods. This was to be carried out to establish the potential savings of adopting an electronic commerce system such as that proposed under Esprit Project No. 25.741 (Buckley, Reynolds, Zarli and Richaud, 1998).

Through a contact in Company A, I was introduced to two of the directors and discussed with them the purpose and proposed structure of the study. It was agreed that the directors would be informed of the results of the study before submission of the thesis. The name of the company would not be revealed in the thesis.

### 3.5 Gathering the Data

#### 3.5.1. Interview with supplier

The Company A contact identified an individual within the supplier organisation who would participate in the study. This person was contacted and agreed to participate. The interview took place and took the following format:

- introductions and explanation of the purpose of the study
- establishment of the process of taking orders and supplying timber to sites
- establishment of details of the administration process involved in the taking and dispatching orders, of preparing and issuing invoices and of collecting accounts.

Form No. 1, which was used to record this interview, is attached as Appendix 3.1.

#### 3.5.2. The site interviews

Company A had two sites active at the time of this study. One was an apartment development in two blocks, the other a mixed development of town houses and apartments in six blocks. The apartment site was four storeys high and construction had reached the second floor level. The mixed development was phased and consequently some blocks were being finished while others were yet at ground floor or first floor level.

Interviews were arranged with site managers and took the following format:

- introductions and explanation of the purpose of the study
- detailing of the process of ordering and taking delivery of timber
- agreeing dates for observation of the process

Form No.2, which was used to record the interviews, is attached as Appendix 3.2.

It became clear in the interviews that the nature of the site would affect the way in which timber was handled on site. This would make attempts at direct comparison meaningless as a more costly procedure on one site might be due to a different form of construction rather than a lack of efficiency. It was decided therefore, to concentrate on the apartment site, the supply chain for which was established as shown in Table 3.1.

The third type of interview was held with a member of the purchasing and accounts department in Company A. The aim was to establish the tasks and costs involved in the process of ordering, of

receipt, and of payment for timber purchased from the supplier. Form No. 3, which was used to record this interview, is attached as Appendix 3.3.

### 3.1 Supply chain of timber to the workplace

	Materials Handling Tasks	Cost Type	Cost Details
1	Timber transported from quay	Transport	Flat rate of 3% of timber cost
2	Unloaded in supplier's yard	Labour Plant	Time spent by forklift driver and foreman Duration of use of forklift
3	Timber stored in supplier's yard	Storage	Length of time stored
4	Loaded by forklift for delivery	Plant Labour	Duration of use of forklift & truck Time spent by labourer, truck driver, forklift driver and foreman
5	Delivery to site	Transport	Hire of truck and driver for 2 hours
6	Unloading at site	Plant Labour	Duration of crane use Time spent by crane driver, banksman, labourer, storeman and foreman
7	Storage on site	Storage	Length of time stored
8	Removal from storage and hoisting to workplace	Plant Labour	Duration of use of crane Time of Crane driver, banksman, labourer, storeman and foreman
9	Distribution at Workplace	Labour	Time of labourers

### 3.6 The Materials Handling Process

In gathering the data at the supplier's yard, one delivery from the quay and the loading of timber for four orders to site were observed. As the cost of transportation of the timber from the quay is charged at 3% of the value of the timber, this figure is shown as a constant in all of the observations. The data from the supplier's yard were gathered by observation using Form No. 4, which is attached as Appendix 3.4. Form No. 5, attached as Appendix 3.5 was used to record the observations on the apartment site. During all of the site recordings, it was noted that the lorry had a waiting period between arrival and unloading.

### 3.7 Costs

In allocating cost to the steps in the supply chain, Task 1, transport from the quay to the supplier's yard, is charged by the haulier to the supplier at an agreed rate of 3 % of the value of the timber. Task 5, delivery to site, was taken to have an average duration of 2 hours because while the duration would vary in practice, the variation was probably due more to Dublin traffic than to differing standards of efficiency. In recording the time taken for each bale of timber to go through Tasks 1 to 5, the time taken for a load of timber was recorded and an average value for each bale was established. It was also noted that Tasks 6, 7 and 8 were sometimes bypassed with the timber being unloaded from the lorry and being hoisted directly to the workplace.

The Construction Industry Federation in November 1997 supplied costs, upon which comparisons were made. These are shown Table. 3.2.

#### *3.2 Construction Costs at September 1997*

Cost Element	Cost per hour	Cost per minute
Foreman	£14.78 / hour	£0.25
Labourer	£9.85 / hour	£0.16
Forklift Driver	£10.24/ hour	£0.17
Crane Driver	£10.73 / hour	£0.18
Storeman	£10.24 / hour	£0.17
Forklift	£13.97 / hour	£0.23
Truck (including driver)	£22 / hour	£0.37
Tower Crane	£350/ Week	£0.15

Costs of plant do not include transport costs of the plant to and from site. The tower crane costs do not include any portion of the cost of erecting and dismantling. A rate for a Banksman was assumed as being equal to that of a Labourer. The percentage of the Foreman's time spent supervising each task observed was established during the site interviews and the supplier interview.

Table 3.3 gives details of Observation No.1, noting the duration of each task and a detailed account of the build-up of costs.

### 3.3. Details of Observation No. 1

1 bale contains 300 lengths of timber 2.4m long x 0.072m wide x 0.035 m thick = 1.8144 m <sup>3</sup>						
Action	Cost cause	Time unit	Observation 1			
			Total Duration	Duration min/bale	Cost (bale)	
1 Timber transported from Quay	3% of 1.8144 m <sup>3</sup> x £181/m <sup>3</sup>				£9.85	
2 Unloaded in supplier's yard (24 bales)	Forklift	mins	72.0	3.0	£0.69	
	Driver	mins	72.0	3.0	£0.48	
	Foreman (20%)	mins	72.0	3.0	£0.15	
3 Stored in supplier's yard	Bales are 2.4m x 1.0m = 2.4m <sup>2</sup> stacked 3 high, each takes up 0.8m <sup>2</sup> . Rent on ground = £10/m <sup>2</sup> /year		3 weeks	1.5 week	£0.23	
4 Loaded by forklift for delivery (8 bales)	Forklift	mins	30.0	3.8	£0.86	
	Driver	mins	30.0	3.8	£0.60	
	Foreman (10%)	mins	30.0	3.8	£0.09	
	Lorry + Driver	mins	30.0	3.8	£1.13	
5 Delivery to site (8 bales)	Driving time	mins	120.0	15.0	£5.50	
5a Standing time at site	Standing time at site	mins	12.0	1.5	£0.45	
6 Unloading at site (8 bales)	Tower Crane	mins	63.0	7.9	£1.15	
	Crane Driver	mins	63.0	7.9	£1.34	
	Banksman	mins	63.0	7.9	£1.26	
	Lorry + Driver	mins	63.0	7.9	£2.36	
	Labourer	mins	63.0	7.9	£1.26	
	Foreman	mins	63.0	7.9	£0.19	
7 Storage on site	Bales are 2.4m x 1.0m = 2.4m <sup>2</sup> stacked 3 high, each takes up 0.8m <sup>2</sup> . Rent on ground = £10/m <sup>2</sup> /year		1 week	1 week	£0.15	
8 Removal from storage and hoisting to workplace	Tower Crane	mins	48.0	6.0	£0.88	
	Crane Driver	mins	48.0	6.0	£1.02	
	Banksman	mins	48.0	6.0	£0.96	
	Storeman	mins	48.0	6.0	£0.96	



		Labourer	mins	48.0	6.0	£0.96
		Foreman	mins	48.0	6.0	£0.15
9	Distribute at workplace (average over 6 apartments / 2.5 bales)	2 labourers	mins	1005.0	402.0	£64.32
	Total handling costs					£ 96.99

### 3.7.1 Comparative Costs

Table 3.4 shows the duration and cost in all four observations.

#### 3.4. Duration and Costs in all four observations

		Observation Number							
		1		2		3		4	
Action	Unit	Time	Cost	Time	Cost	Time	Cost	Time	Cost
Timber transported from Quay			£9.85		£9.85		£9.85		£9.85
Unloaded in supplier's yard	mins	3.00	£1.32	3.00	£1.32	3.00	£1.32	3.00	£1.32
Stored in supplier,s yard	weeks	1.5	£0.23	1.5	£0.23	1.5	£0.23	1.5	£0.23
Loaded by forklift for delivery	mins	3.75	£2.68	4.63	£3.37	4.13	£2.95	21.51	£3.84
Delivery to site	mins	15.00	£5.50	15.00	£5.50	15.00	£5.50	15.00	£5.50
Standing time at site	mins	1.50	£0.45	0.50	£0.15	3.13	£0.94	0.75	£0.23
Unloading at site	mins	7.88	£7.56	9.00	£8.64	8.50	£8.16	10.25	£9.84
Storage on site	weeks	1.00	£0.15	1.00	£0.00	1.00	£0.15	1.00	£0.00
Removal from storage / hoisting to workplace	mins	6.00	£4.92	0.00	£0.00	7.00	£5.74	0.00	£0.00
Distribute at workplace	mins	402.00	£64.32	438.00	£70.08	484.80	£77.57	396.00	£63.36
Total handling costs			£96.99		£99.08		£112.42		£94.17

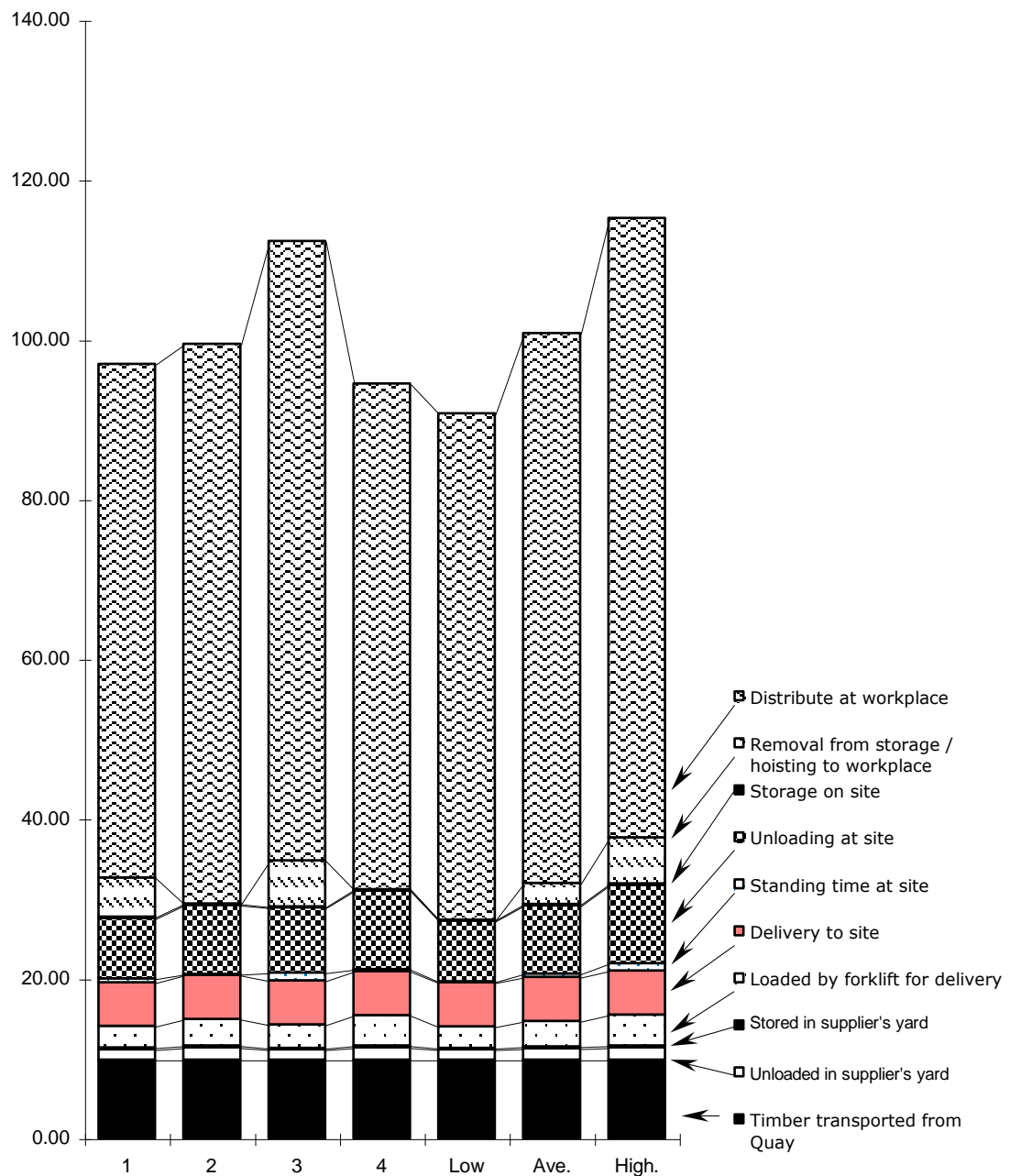
Table 3.5 shows a summary of costs across all four observations and compares the data to illustrate average, minimum and maximum costs for each part of the process. This shows an average percentage add-on of 27% to 35%, which compares favourably to the values of 34-60% shown by Wegelius-Lehtonen (1995). However, as the element being examined is probably the most efficiently handled by this company, it is probable that the percentage add-on for different types of timber is approaching or even exceeding 60%.

#### 3.5 Summary of Costs across all four observations

Action	Observation No.				Low	Ave.	High.
	1	2	3	4			
Timber transported from Quay	9.85	9.85	9.85	9.85	9.85	9.85	9.85
Unloaded in supplier's yard	1.32	1.32	1.32	1.32	1.32	1.32	1.32
Stored in supplier's yard	0.23	0.23	0.23	0.23	0.23	0.23	0.23
Loaded by forklift for delivery	2.68	3.31	2.95	3.84	2.68	3.19	3.84
Delivery to site	5.50	5.50	5.50	5.50	5.50	5.50	5.50
Standing time at site	0.45	0.15	0.94	0.23	0.15	0.44	0.94
Unloading at site	7.56	8.64	8.16	9.84	7.56	8.55	9.84
Storage on site	0.15	0.00	0.15	0.00	0.00	0.08	0.15
Removal from storage to workplace	4.92	0.00	5.74	0.00	0.00	2.67	5.74
Distribute at workplace	64.32	70.08	77.57	63.36	63.36	68.83	77.57
Total handling costs	96.99	99.08	112.42	94.17	90.65	100.66	114.99

Material Cost (i.e. cost of one bale of timber) = £328.41				
Handling costs as a % of material cost		27.60	30.65	35.07

Figure 3.1 illustrates the summary of costs using a bar chart with the “Low” bar showing the consistent achievement of best practice in the current process.



*Figure 3.1 Comparison of Costs*

### 3.8 Establishing Best Practice from the first part of this Study

1. List the tasks in the materials handling process
2. Eliminate the unnecessary tasks
3. Examine the remaining tasks and re-engineer these tasks where necessary with a view to reducing costs to a minimum
4. Analyse the interface areas.

#### 3.8.1 Tasks in the Materials Handling Process

- 1 Timber transported from quay
- 2 Unloaded in supplier's yard
- 3 Timber stored in supplier's yard
- 4 Loaded by forklift for delivery
- 5 Delivery to site
- 6 Unloading at site
- 7 Storage on site
- 8 Removal from storage and hoisting to workplace
- 9 Distribution at Workplace

#### 3.8.2 Elimination of unnecessary tasks

It may be possible to eliminate Tasks 2 to 5 inclusive, at an average cost saving of £9.24 per bale (almost 3% of the cost of the timber), by arranging direct delivery to site. Tasks 7 and 8 could also be eliminated (as could the standing time of the delivery truck while awaiting unloading) at a further average cost saving of £2.19 per bale.

#### 3.8.3 Examination of remaining tasks

Task 9, distribution at the workplace, is obviously a major cost centre and should be scrutinised carefully. Two and a half bales are required for six apartments and the fact that they must be split and carried from one apartment to another is the cause of the cost. Could the bales be made up to the exact size required for the apartment and hoisted directly to the workplace? The new sized bales would probably have to be made up in Sweden and the cost of this should be established. Could the bales be split when they arrive on site and be re-hoisted to their required area? This process would require extra manpower and crange but could result in a saving over the current practice.

### 3.8.3 Analysis of Interface Areas

To analyse the interfaces the following procedure is adopted:

1. List the tasks in the changed process
2. Establish who will carry out the task
3. Determine the changes within the task
4. Establish the potential interface problems affecting those performing preceding and succeeding tasks
5. Propose action to promote positive reaction to the change.

Table 3.6 summarises the analysis. Tasks 2, 3, 4, 5, 7 and 8 were eliminated in sub-section 3.8.2 above.

### 3.6 Interface Analysis

	<i>Task</i>	<i>Performed by:</i>	<i>Change</i>	<i>Interface Problems</i>	<i>Proposed Solution</i>
1	Timber transported from quay	Transport Company	Timber now comes directly to site rather than to supplier's yard.	Different distances from the quay may result in different haulage rates Drivers may be unsure of site locations. Site might not need full load of timber. Timber might not always be available when required	Search for means by which an average cost can be agreed. Ensure all drivers are given maps showing exact location of sites and a contact number in case of difficulties. Co-ordinate load sizes with size of truck available Ensure transport company are involved in project planning process in relation to materials delivery requirements

6	Unloading at site	Crane + Driver, Banksman, Foreman Lorry + Driver, Labourer, Foreman	This is already being achieved in many cases	Puts Foreman under pressure to ensure timber can always be unloaded directly to the workplace	Requires tighter planning and improved site control procedures
9	Distribution at Workplace	No obvious change in original task available. Any change, as suggested in subsection 3.8.3, would require interface analysis.			

### 3.9 Conclusions from the first part of this Study

Through constantly achieving best practice in the current process, an average saving of 3% of the cost of the material can be immediately achieved. Elimination of tasks 2 to 5 will bring this saving up to almost 6%. Further savings could be achieved by re-engineering the remaining tasks in the process. Bearing in mind that the process of handling this type of timber is already well thought out, it is probable that a higher percentage saving could be achieved across all of the materials. Further examination and re-engineering of all material handling processes could realise even greater savings. For Company A, this possibility is worthy of further investigation, as a reduction in materials handling costs in the region of 10% of the cost of the materials would realise a further £2,500,000 in profit per annum.

### 3.10 Recommendations to Company A, from the first part of this Study

1. Investigate the possibility of deliveries from quayside directly to the site
2. Examine the potential for standardising the size of the timber bales to that required to complete one apartment. Analyse the cost of the options
3. If the cost of step 2 above is still too high, seek alternative means for distribution of the timber at the workplace (re-engineering the task)
4. Provide training in the use of new process
5. Carry out a pilot project using the new process on one site
6. Assess the results
7. Amend and implement company-wide.

### 3.11 Administration Costs

In relation to the administration costs of ordering, delivering and making payments, the data gathered gives an indication of the add-on cost involved. Table 3.7 shows a build up of Company A's administration costs in processing a materials order. This information was compiled from estimates given by the interviewees, rather than the recording of observations. They may therefore be the values that the interviewees would like to see and consequently could be conservative.

#### 3.7 Administrative Cost of Processing an Order

	Action	Time (Min)	Rate/Min (rounded to the nearest penny)	Cost incurred by Supplier	Cost incurred by Contractor	Total Cost
a	Phone call placing / receiving order	5		£0.00	£0.22	£0.22
b	Order given / received by phone	5	£0.17	£0.85	£0.85	£1.70
c	Order form filled out / receipt of order recorded	5	£0.17	£0.85	£0.85	£1.70
d	Order confirmed by Fax	3		£0.00	£0.11	£0.11
e	Order brought to Orders Office	5	£0.17	£0.85	£0.00	£0.85
f	Order given to dispatcher	2	£0.17	£0.34	£0.00	£0.34
g	Order given to loader	2	£0.17	£0.34	£0.00	£0.34
h	Delivery note prepared and given to driver	5	£0.17	£0.85	£0.00	£0.85
i	Load checked at gate	2	£0.17	£0.34	£0.00	£0.34
j	Goods checked on arrival, delivery note signed	5	£0.17	£0.00	£0.85	£0.85
k	Goods received note (GRN) filled out	2	£0.17	£0.00	£0.34	£0.34
l	Bring delivery note and GRN to site office	5	£0.17	£0.00	£0.85	£0.85
m	Send delivery note to Head Office	1	£0.17	£0.00	£0.17	£0.17
n	Delivery note given to accounts department	2	£0.17	£0.00	£0.34	£0.34
o	Amount included in supplier's account	2	£0.17	£0.00	£0.34	£0.34
p	Invoice issued	5	£0.17	£0.85	£0.00	£0.85
q	Invoice checked against GRN	5	£0.17	£0.00	£0.85	£0.85
r	Payment authorised	2	£0.17	£0.00	£0.34	£0.34
s	Cheque written and left ready for collection	2	£0.17	£0.00	£0.34	£0.34
t	Call for Cheque (10% of 1 hour call) (cost of call calculated as follows: Car costs 10 miles @ 52p / mile + Salesman cost @ £20 / hour = £25.20 / hour.	6		£2.52	£0.00	£2.52
u	Cheque given to accounts dept.	2	£0.17	£0.34	£0.00	£0.34
v	Cheque included on lodgement slip	2	£0.17	£0.34	£0.00	£0.34
w	Cheque lodged in bank	2	£0.17	£0.34	£0.00	£0.34
x	Bank charge for lodgement			£0.36	£0.00	£0.36
	Total Administrative Cost			£9.17	£6.45	£15.62



### 3.12 Establishing best practice from the second part of the study

1. List the tasks in the administration process
2. Eliminate the unnecessary tasks
3. Examine the remaining tasks and re-engineer these tasks where necessary with a view to reducing costs to a minimum
4. Analyse the interface areas.

#### 3.12.1 Tasks in the Administration Process

As shown in Figure 3.8, the tasks in the administration process, each of which involves a cost to the supplier or the contractor, are as follows:

- a. Phone call placing / receiving order
- b. Order given / received by phone
- c. Order form filled out / receipt of order recorded
- d. Order confirmed by Fax
- e. Order brought to Orders Office
- f. Order given to dispatcher
- g. Order given to loader
- h. Delivery note prepared and given to driver
- i. Load checked at gate
- j. Goods checked on arrival, delivery note signed
- k. Goods received note (GRN) filled out
- l. Bring delivery note and GRN to site office
- m. Send delivery note to Head Office
- n. Delivery note given to accounts department
- o. Amount included in supplier's account
- p. Invoice issued
- q. Invoice checked against GRN
- r. Payment authorised
- s. Cheque written and left ready for collection
- t. Call for Cheque (10% of 1 hour call)
- u. Cheque given to accounts dept.
- v. Cheque included on lodgement slip

- w. Cheque lodged in bank
- x. Bank charge for lodgement

### 3.12.2 Elimination of unnecessary tasks

1. There is a possibility of eliminating tasks a, b, c, e and f by faxing the order directly to the dispatcher (Potential cost saving of £4.92)
2. Tasks s-v could be replaced by making a payment directly to the supplier's bank giving a further potential cost saving of £3.54

The total saving achieved from eliminating the unnecessary tasks is £8.46, which equals 54% of the administration costs.

### 3.12.3 Examination of remaining tasks

The majority of the remaining steps required movement of information from one place to another. A person physically carrying the information usually does this. The entire process could be re-engineered as follows:

- On preparation of the materials schedule, classify each material with a standard code to be used by both supplier and contractor
- When material is required, place the order electronically using the code for the material and the quantity required, delivery time, etc. This order must produce a unique signature, for example, a barcode
- E mail the order directly to the suppliers dispatch department where receipt of the e mail will automatically generate loading and delivery activities
- On the arrival of the material to site, the barcode is read to record receipt. This alerts the contractor's accounts department of receipt of the goods and alerts the supplier of acceptance of the goods. It automatically generates an invoice for the goods and prompts transfer of the money to the supplier's account on the requisite date.

This procedure could remove further cost from the process. If the cost removed was of the order of 90% of the administration costs as achieved by Laage-Hellman and Gaade, (1996); this would reduce the cost per invoice to £1.52.

### 3.12.4 Analysis of Interface Areas

To analyse the interfaces the same procedure as uses in the materials handling process is adopted:

1. List the tasks in the changed process
2. Establish who will carry out the task
3. Determine the changes within the task
4. Establish the potential interface problems affecting those performing preceding and succeeding tasks
5. Propose action to promote positive reaction to the change.

Only tasks d and w undergo an interface change as tasks a, b, c, e, f, s, t, u, v and x were eliminated in sub-section 3.12.2 above and there is no change in tasks g-r. Table 3.8 summarises the analysis following the removal of unnecessary tasks and ignoring the unchanged tasks.

### 3.8 Interface analysis in administration system

	<i>Task</i>	<i>Task performed by:</i>	<i>Change</i>	<i>Interface Problems</i>	<i>Proposed Solution</i>
d.	Order placed by Fax	Site Clerk	No telephone call to supplier  Fax goes directly to dispatch area.	Potential lack of accurate information on order form.  Someone in dispatch must be given responsibility for incoming faxes	Training in the use of standard forms  Training in new procedures
w.	Payment lodged in bank	Accounts department	Procedure for payment must be worked out with bank and with supplier	Payment delayed for any reason  Supplier unsure if payment has been made  Delay in lodgements reaching the supplier account	Supplier must be informed if payment is to be delayed for any reason  Supplier must be notified that the transaction has taken place  Timing of payments must be agreed between contractor and supplier so that the supplier knows when to expect payment  Training must be provided to ensure that the new procedure always works

In the event of an electronic commerce based system being implemented, the entire system will change, resulting in a detailed interface analysis such as that in Table 3.9.



### 3.9 Interface Analysis in Electronic Commerce System

	<i>Task</i>	<i>Task performed by:</i>	<i>Change</i>	<i>Interface Problems</i>	<i>Proposed Solution</i>
1.	Classification of materials with standard code	Estimator or Quantity Surveyor	Totally new task	Contractor and supplier must use same code Computer systems must be able to communicate electronically	Use industry standard codes
2.	Place the order electronically directly to the supplier's dispatch department	Site clerk / Dispatch clerk	Use of e-mail or internet based system	Potential lack of critically important information	Training in use of new process
3.	Acceptance of material on site. Prompting of payment to supplier	Site clerk	New system involves a barcode being read to record receipt. This alerts the contractor's accounts department of receipt of the goods and alerts the supplier of acceptance of the goods. It automatically generates an invoice for the goods and prompts transfer of the money to the supplier's account on the requisite date.	Relies totally on site clerk to properly read the barcode and transfer the information into the main computer system  Potential problem when goods are received but do not conform to the order  Potential security concerns in payment stage	Detailed training to be given to those operating the system.  Procedure to be worked out for dealing with non conformance  Secure payments systems to be developed

#### 3.13 Overall conclusions from the study

It was found that Company A is currently incurring significant materials handling costs, approximately ranging from 27% to 35% of the cost of the material (with an average of 30%). By constantly achieving the most efficient methods in the current practice, the materials handling costs could be held at 27% of material costs giving an average saving of 3%.

The elimination of the unnecessary tasks in the materials handling process could produce a further saving of 3% giving a total a saving of 6%. Applied across the board to all materials, assuming an annual turnover of £50 million and materials cost to be 50% of turnover, this would result in a saving of £1.5 million per annum. Further savings could be achieved by re-engineering the distribution process and by the use of an e-commerce system that could potentially reduce administration costs by up to 90%.

### 3.14 Issues for the Construction Industry at large

These results suggest that the area of materials management is one where Irish Construction Companies generally could achieve major cost savings, if they are prepared to analyse and re-engineer the current processes used. This would involve carrying out a detailed analysis of their purchasing and supply systems, across the entire range of the materials in use, with the aim of eliminating unnecessary tasks. Remaining tasks would then be examined with a view to achieving further cost savings.

The e-commerce system proposed is not currently in use in the Irish construction industry but is similar to that in use by Skanska (Laage-Hellman and Gaade, 1996) and that proposed by Adcock (1996). It is widely used by other sectors such as the retail sector, but its limited use to date in the construction industry is probably due to the differences between construction and other industries as illustrated in Table 3.10.

### 3.10 Comparison of Industry Types

	Retail	Manufacture	Construction
1. Products			
a. Product Type	Large range of small products	Small range of products mass produced	Unique products (i.e. one-off structures)
b. Product demand	Range of products driven by demand. Range can change quickly to suit demand	Range driven by demand. Changes to range take time as new skills and machinery may be necessary	Range of structures remains reasonably stable. Demand is cyclical.
2. Suppliers			
a. Materials	Constant demand for supplies of similar goods	Constant demand for supplies of similar raw materials	Irregular demand for a wide range of goods
b. Location	Supplier delivers to either one location or deliver on a regular basis to a number of locations	Supplier delivers to one location	Supplier delivers a wide range of goods in differing quantities to several locations
c. Duration of supply contract	Long Term	Long Term	Short Term
d. Relationship	Co-operative	Co-operative	Adversarial
3. Mechanisation	Limited scope for application	Widespread application	Varied application
4. Automation	Widespread use particularly in stock control and purchasing	Widespread use in production and purchasing	Limited application

Laage-Hellman and Gaade also note the following potential factors for limited use of e-commerce in construction:

1. A need for a standard coding system for materials - this is being addressed by the development of the STEP system and by the use of EDIFACT (The United Nations EDI standard for Administration, Commerce and Transport).
2. A lack of IT competence - this factor is reducing in importance as more IT training is provided in the construction industry
3. Incompatibility in inter-company procedures - requires longer term relationships to be developed
4. Lack of trust - evidenced in the survey as detailed below
5. Lack of support / training
6. Mistrust of technology
7. Cultural factors
  - a. Supply based on price alone
  - b. Short relationship

Zarli, Richaud, & Buckley (1998) suggest that the slow pick up of e commerce in the construction industry is due to:

- Lack of support for different systems
- High entry level expenses
- Limited capacity for future growth
- Need to organise the enterprise around the application
- Fixed infrastructure requiring long term relationships that are not traditionally found in the industry
- Limited security and transactional support.

Buckley et al. (1998) suggests that the use of Electronic Data Interchange and e commerce in the construction industry must take these factors into account and allow low entry-level cost for such systems. The use of the World Wide Web is proposed as a solution to this problem through the EU Esprit Project 25.741 (Wonda), which aims to meet the needs for Enterprise Information Systems and e commerce in the construction and banking industries. Wonda aims to deliver a solution suitable for contracting firms enabling:

- take-up by Small to Medium Enterprises (SMEs)
- incremental value-added growth
- mobile computing for location independent access by project managers and quick set-up of virtual enterprises reflecting both the short customer-supplier relationships in the industry and the need of construction firms to constantly re-configure and re-invent themselves.

Adcock (1996) states that the savings due to e commerce are only part of the benefits of such a system. Developing new inter-organisation systems provides for greater accuracy, greater communication, improved business relationships, reduced administration, greater use of just-in-time deliveries, lower storage costs, greater flexibility and an up-to date information base for use across the company. Indeed improvement in any of these factors would be possible in the case of the two organisations involved in the study, as the atmosphere between them was noted as being profoundly adversarial as evidenced by the following comments:

“We let the Supplier worry about his own costs. It’s nothing to do with us” (*Site Manager’s comment during the introductions to a site interview*)

“Regardless of what you do with the results you find (during the study), it won’t change the attitude of the contractors. If they can get something for a penny less down the road, you won’t see them for dust!” (*Supplier’s comment during the supplier interview*).

Value is often perceived as being equal to the price paid for the materials. The possibility of use of the supplier’s expertise in relation to availability, handling, etc., is not often examined. Such involvement can lead to a 10% reduction in construction times (Agapiou, Flanagan, Norman and Notman, 1998) and is now widely accepted in other countries such as Denmark, Sweden and Japan (Day, Dandy and Townsend, 1996).

### 3.15 Conclusion

It is clear that a cultural shift is required in the way we deal with the process of materials management in the Irish construction industry. The distance that the industry has to go to make this cultural shift is apparent from the comments received in the course of the survey, from both the supplier and the contractor. A move towards a partnership approach, based of mutual respect and



on increased benefit between organisations, is required. With competition still keen in the industry and profit margins being squeezed tighter every day, the move to such co-operation may soon be a necessity for developing and maintaining a competitive edge.

The potential rewards of applying change in materials management are considerable. Case study 1 was carried out in a company that combined the roles of developer, designer and builder. The systems used to control the construction activities and administration of the company involved are finely tuned as the product being constructed varies little from project to project. Nonetheless, a potential saving of 6% of materials costs were found. With a typical company whose systems are not as finely tuned, due to a lesser degree of control of the entire construction process, a potential cost saving of 10% would be realistic.

The changes necessary to achieve this position can be summarised as follows:

1. A value engineering approach applied to the process of materials management in order to minimise the tasks in the process
2. A re-engineering approach to the tasks that remain in the process
3. A TQM approach, with continuous improvement being actively sought in interface areas in the system
4. A strategic approach with a view to developing partnering arrangements between contractors and suppliers
5. An innovative and open-minded approach to be taken to the potential of the use of new technology.

In this study, the use of the Generic Change Model was effective in that it ensured all of the relevant issues were addressed. To further test this model, a case study is required that goes into stage 5 and examines the interfaces. Such a case study is used in Chapter 4.

## Chapter 4

### Case Study 2

#### Examination of a Contractor's Plant Management System

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## 4.1 Introduction

The previous chapter examined the potential areas of improvement in the management of materials in a construction company. This chapter examines the potential for improvement in the management of plant.

The chapter sets out to examine the course of actions involved in changing a system within an organisation through a case study carried out in the Autumn and early Winter of 1997.

The stages of the Generic Change Model (Figure 2.3, Page 39) are adhered to as follows:

- Subsection 4.2 shows the Directors recognising that the system could be improved - (Stage 1)
- Subsection 4.2 also sets the objectives of the change programme - (Stage 2)
- Subsections 4.3, 4.4, 4.5 and 4.6 concentrates on the earlier stages of the change programme, mapping of the processes and describing strengths and weaknesses of the current system - (Stage 3)
- Subsection 4.7 identifies the changes required - (Stage 4)
- Subsection 4.8 identifies the individuals and groups who will be most affected by the change and carries out an analysis of the interface areas. The probability of resistance to change is discussed, as is the approach to minimising such resistance through active involvement of those affected - (Stage 5)

The chapter concludes with a brief summary of plant management issues that arose in this case study that could be addressed by the industry at large.

## 4.2 Aims of the Change Programme

Company B operates in the new-build, refurbishment and maintenance sectors. It has an annual turnover of approximately £10 million, is 120 years in existence and has a strong sense of tradition. Many of the employees have spent their entire working lives with the company and some families have several generations of service with the company. Consequently, the systems operating within the company are generally long established with many having been developed by employees rather than by the management.

The Directors of Company B have realised that their system for controlling plant is inefficient and, when approached, they saw this study as a possible opportunity to research and address this problem. The objectives of the study were agreed as follows:

1. To examine the system currently in place and to report on the following:
  - The current processes for planning and controlling plant use within the company
  - The strengths and weaknesses of the current system.
  - A course of action for eliminating the weaknesses within the system.
2. To establish the factors for successful introduction of such a change programme
3. To identify general issues of more effective plant management which could be addressed by the construction industry as a whole.

#### 4.3 Research Method

To examine the current system of managing plant within Company B, the following approach was adopted:

1. Compile an inventory of all plant items used by the company
2. Interview a number of senior management personnel and Foremen, to establish the current methods of planning and controlling plant use
3. Analyse the responses of the interviewees to establish the strengths and weaknesses of the system
4. Establish a course of action to improve the effectiveness and cost efficiency of the system.

#### 4.4 Plant Inventory

As most of the plant in the company is held on site, it was necessary to carry out a survey of all plant on all sites and at the workshop at Head Office to ascertain what plant was being used by the company at any one time.

In order to find this information, a plant record form (see Appendix 4.1) was compiled and distributed to each site. Each Site Foreman was instructed to fill in the form and return it to head office with the weekly time sheet. When the information on the sheets was combined, the result was a full record of the plant in use by the company from week to week. In order to ensure accuracy, the forms were sent to site each week starting on 31st October 1997. By the 21<sup>st</sup> November 1997, all Foremen were completing and returning the forms. The following plant categories were identified:

- a) Small mechanical
- b) Small non- mechanical
- c) Large non-mechanical
- d) Administrative.

No large mechanical was in use at the time of the compilation of the Plant Inventory

Table 4.1 shows a breakdown of the plant in use at the time of the survey.

The records also show that the Foremen take four basic toolkits, owned by the company, from site to site.

#### 4.1 Plant in use at the time of the survey

Small mechanical plant			Small non-mechanical plant		
Description	No.	Hired	Description	No.	Hired
Skil Saws	12	3	Extension leads	26	0
Con Saws	4	0	2.4m ladders	13	2
Drills (110 v)	12	6	1.8m ladders	9	0
Drills (220 v)	1	0	3m extension ladders	3	0
Transformers	16	3	4m extension ladders	2	2
Belt Sanders	4	0	Tool Box	3	0
Orbital Sanders	2	0	Brushes	12	0
Routers	3	2	Shovels	16	0
Jigsaws	10	3	25mm Ø Spit Bit	1	0
Makita Plane	1	0	Junction Boxes	8	0
Cordless Drills	10	0			
Formica Trimmers	2	0			
Sabre Saw	1	0			
Hilti Gun	6	4			
Kango Hammer	4	3			
225mm Ø Grinder	5	0			
Large non-mechanical plant			Administrative plant		
Aluminium Towers	6	4	Industrial vacuum cleaner	3	0
Lifts of Kiwk Stage Scaffolding*	2	0	Dumpy Level, Tripod and Staff	4	0

\* Note:

The exact number of pieces of scaffolding was not recorded. However, a lift of scaffolding was described as being 2 metres high by 2.4 metres long by 1.2 metres wide.

## 4.5 Analysis of the Plant System

The details of how the current system works were established in a series of loosely structured interviews using the form attached as Appendix 4.2. Two senior management personnel and four Foremen were interviewed. The following is a summary of the responses to the questions posed during the interviews.

### 4.5.1 Procedures for deciding on the Plant Requirements for a Project

The current procedures for establishing the plant requirements for a project are as follows:

- a) The Foreman decides on all of the plant requirements except the large mechanical plant for smaller projects. The Contracts Manager chooses large mechanical plant having first consulted the Foreman. On larger projects the Contracts Manager is also involved in the choice of administrative plant and non-mechanical plant.
- b) The factors for choice of plant vary with the type of project being undertaken. All Foremen expressed the opinion that the type of operation is the most important factor. Both Directors, however, initially stated that cost is the most important factor, followed by all other factors.
- c) Plant requirement decisions involving the Contracts Manager are made “a few weeks” in advance of the plant being needed on site. The Foremen decide on their requirements on a daily, or at most, weekly basis. There is no other evidence of any formal plant planning procedures in the company.

### 4.5.2 Plant Control Procedures

Procedures for controlling plant on site are informal. The following procedures are loosely applied:

- a) Small plant is brought on and off site by the Foreman as necessary or is delivered by the plant hire company. Small items are sometimes (but not often) swapped between sites in close proximity to each other. There is no process for recording such a transfer. The Foreman requests large plant from head office. Delivery is arranged by head office. Administrative plant is usually ordered on site by the Foreman and is delivered and removed using the company van.
- b) There is no formal plant monitoring process on site. Foremen responded that they decide when a plant item is no longer required and arrange for its removal from site.



- c) On large sites, plant is locked in a steel box during non-working hours. On smaller sites, the Foreman either takes the small plant items home at night or they are left “in a safe place” on site.
- d) Small items are sometimes collected from or returned to the plant hire company if the Foreman, or the company van, was passing by the plant hire company premises. The Foreman generally collects any extra plant necessary for the day’s work from head office in the morning. This plant is returned that evening or on the following morning. Head office arranges the removal of large plant from site once notification is received from site.

#### 4.5.3 Obtaining Plant at short notice

At times, plant requirements are identified at very short notice. The plant item required could be at any location including head office, another site or the plant hire company premises. In such the Foreman or a Tradesman would leave the site in order to obtain the plant item. The individual is usually back on site in one hour and the company van or private transport is used in this situation.

#### 4.5.4 Hired Plant

Figure 4.1 shows the procedure that is used when hiring plant.

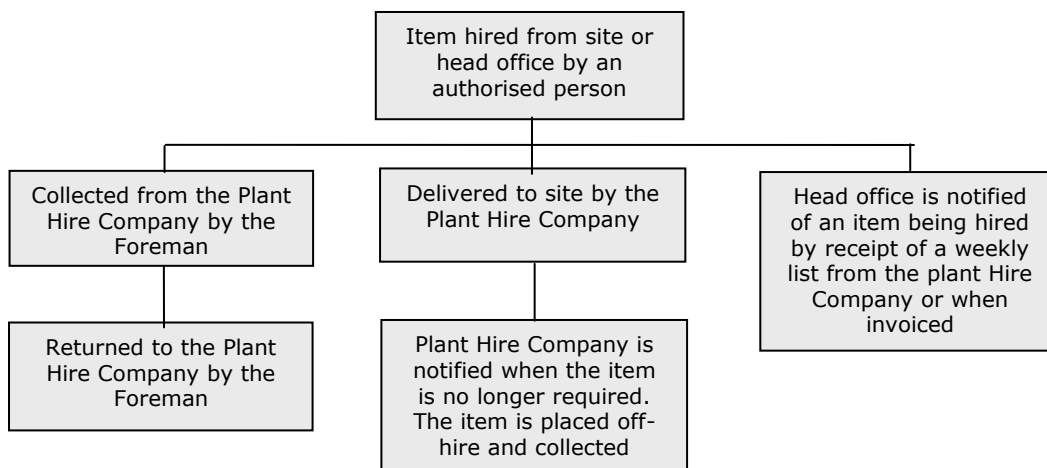


Figure 4.1 Procedures for Hiring Plant

The following people are authorised to hire plant:

- The person in charge of the work on site (usually the Foreman)
- A supervisor of a trade or of a section of work

- The Contracts Manager
- A small number of sub-contractors' Foremen.

Plant Hire cost agreements roll on from year to year. The Contracts Manager checks the prices being charged against other plant hire companies. Practically all of the plant on-hire is hired directly from site. The site does not inform head office of items on-hire or of items that have been put off-hire. The first indication which head office receives of hired items is from the fortnightly list of items on hire that it receives from the plant hire company. The only record head office receives of the duration of hire is the invoice from the plant hire company.

#### 4.5.5 Maintenance of Plant

There is no documented plant maintenance system in this company. There is an emergency service that is supplied by the plant hire company under which it agrees to repair any damaged plant item that is owned by the company. The company is charged for this service on a time and materials basis.

#### 4.5.6 Plant Training & Safety

The following issues emerged:

- a) The company policy in relation to safety is in accordance with current legislation in that it produces a safety statement for each project. There are, however, no formal procedures in place to ensure that all aspects of the safety statement are implemented in relation to use of plant.
- b) If an operative expresses that he is unfamiliar with a specific item of plant, he is instructed in its use either by another operative or by the person delivering the plant to site.
- c) Items of plant are not regularly inspected in respect of safety or proper working order.

#### 4.6 Strengths and Weaknesses of the Plant System

It is evident that there is a working system for controlling plant in this company. It is effective in many areas but it does have its faults. These can be more closely examined once each strength and weakness of the system is clearly identified.

##### 4.6.1 Strengths

1. There is a clearly defined system in place showing the responsibility of senior management and of site management for the control of different types and categories of plant.
2. The system is very flexible and consequently work on site is rarely delayed due to non-availability of plant.

#### 4.6.2 Weaknesses

1. The control of the current system is not subject to a single point of responsibility. This leads to a lack of financial control over the system.
2. There is no plant tracking process in place.
3. It is possible for plant to be hired on one site while similar plant is lying idle on other sites.
4. Head office has no knowledge of when a small item of plant is hired on site, other than when the invoice arrives from the plant hire company or when the company is issued with a list of plant currently on hire. This list can arrive up to two weeks after a plant item has been hired.
5. There is no evidence of project planning in relation to plant.
6. There is no overall plant maintenance policy other than an emergency repair service.
7. Training in the use of plant (where given) is informal, undocumented and is not subject to any control by management.
8. Security of plant on site (particularly on small sites) is sometimes lax and open to abuse.

#### 4.7 Suggested Changes to the Plant System

The route to maximising efficiency and effectiveness of the system lies in the elimination of the weaknesses without compromising the strengths.

##### 4.7.1 Single point of responsibility

All of those interviewed agreed that single point of responsibility over the plant system was desirable. One person would take full responsibility for all aspects of the system including planning, issuing, transfer and return of plant. It was also suggested that this person would be in a position to make regular inspections of plant being used on site. The suggested resources available to this person varied and included a computer, a workshop/repair area/store and transport to get from site to site.

The views of the interviewees differed on the type of person required for the job. Suggestions of the type of person required included: a fitter, a Foreman and a person combining this position with another position such as health and safety officer. It was agreed by all that this person would have some experience of building, be a good communicator, be organised and have the authority to issue instructions. One of the management personnel interviewed expressed a preference for a relatively young individual with building and health and safety qualifications.

It was agreed that the person who takes up this role would be involved in project planning particularly in relation to planning the use of plant in a project.

#### 4.7.2 Plant Tracking System

A record of the location of each plant item must be established and maintained at least on a weekly basis. Notification of movement of plant must be entered into the system on a daily basis. This will require each item of plant to be given a unique identification number that must be marked or stamped on the item in some way. The location of the item can be tracked manually or by computer. A simple system such as a spreadsheet or database or a specialised package such as *Hiremate*, could be used. Bar coding systems are also available for this purpose.

#### 4.7.3 Full Use of Plant

In order to avoid the hiring of extra plant when the same item may be idle on another site, the person hiring the plant must first check that no similar item is available elsewhere within the company. This is only possible when an accurate tracking system is in place. A phone call to head office would then avoid unnecessary hiring.

#### 4.7.4 Notification to Head Office of items on Hire

If a plant item is required on site and a phone call is made to head office to check if an item is currently available, this same phone call can be used to inform head office that an item is going to

be hired. Those who ignore the requirement to inform head office would no longer be allowed to hire equipment directly from site.

#### 4.7.5 Plant Maintenance

A planned preventative maintenance programme for all plant should be put in place. This would include regular inspections of plant in use and planning of downtime for plant due for maintenance.

#### 4.7.6 Training in Plant Use

Currently there is no formal training system in place for the use of plant. This is a problem across the industry and not just in this company (for example, a dumper driver is not required to have a driving licence). However, if an operative has an accident, the company will be judged negligent in court as no instruction has been provided. This can be tackled within the company by setting up a simple training and monitoring programme. The development of the Construction Skills Certification Scheme (CSCS), as recommended in the Strategic Review of the Construction Industry (CIC/DOE, 1997), would greatly assist in the solution of this problem at site level.

#### 4.7.7 Security of Plant on Site

All sites must be provided with secure storage for plant. The type and nature of such storage must be established at the outset of the project between the Contracts Manager and the Foreman.

#### 4.8 Analysis of Interface Areas and Establishment of Critical Success Factors

The suggested changes in the plant control system will affect several people within the organisation as they come into contact with new tasks and processes. To establish the factors required for successful introduction of the change an interface analysis is carried out. This identifies the people concerned and the interface that they will have with changed activities. A summary of this analysis is shown in Table 4.2.

In summary there are four main issues arising from this analysis that will be critical to the success of the change programme, namely:

- eventual users of the process must be given a leading role in the development and the ongoing improvement of the new tasks/processes
- training to be given in the use of any new tasks/processes
- incentives to be given for positive use of the new tasks/processes
- use of latest technology in maximising the efficiency of the new tasks/processes.

A successful change programme will combine these factors with:

- senior management support for the change
- careful implementation of a pilot project of a changed process
- feedback from the users of the process to ensure continuous improvement.

## 4.2 Analysis of Interface Areas

	<i>Characteristics of current system</i>	<i>Characteristics of plant system incorporating proposed changes</i>	<i>Persons affected by change</i>	<i>Interface Problems</i>	<i>Proposed Solution</i>
1.	Project plant planning done on a day to day basis	Project plant planning done on at: <ul style="list-style-type: none"> <li>• pre-contract</li> <li>• post-contract</li> </ul> Post contract broken into: <ol style="list-style-type: none"> <li>1. Long term (duration of project)</li> <li>2. Medium term (monthly)</li> <li>3. Short term (weekly)</li> </ol>	Contracts Manager Foreman	Potential lack of clarity in new roles. Planning process will involve much more consultation between Contracts Manager and Foreman. The Foreman must become more proactive and outspoken in this process	Training required for Contracts Managers in planning techniques and in the use of planning software  Foremen must be trained in formal project planning techniques
2.	Large degree of on-site authority	Lower level of authority and higher level of accountability	Foreman	Potential negative reaction of Foremen to a perceived lower level of authority	Foremen to be centrally involved in the development and implementation of new tasks/processes. Incentives for successful implementation
3.	Flexibility	Less flexibility	Foreman	As 2 above	As 2 above
4.	Weak recording / notification process	More site records of plant required	Foreman	Foremen may resist extra administrative work	Training required in record keeping. Incentives for consistent accurate record keeping
5.	Poor Head Office control	Better Head Office control	Contracts Manager Admin. staff	Potential for lack of clarity on responsibility for plant control process	Development of plant database and training in the use of such database. Responsibilities to be clearly defined
6.	Potential under-use of plant	Greater use of Plant	Site staff	Will have to allocate more time to short-term plant planning	Incentive to promote greater use of plant
7.	No maintenance system	Planned preventative maintenance system in place	Plant Manager / Fitter	Will require a change from the "if it's not broken, don't fix it" attitude	Development of new maintenance system by those who will operate the system
8.	No formal training system	All operatives to be fully trained in the use of plant	Training Manager / Plant operators	Operators will be away from work place during training	Cover to be arranged for operators on training
9.	Inadequate security	Level of security to match risk to plant	Foreman Site operatives	Perceived new lack of trust between Foreman and operatives	Security procedures to be developed by Foremen in consultation with site operatives

La Marsh (1995) notes that people have problems with change and that any change project that does not factor in these and address them in a systematic, structured way, is doomed to fail. She identifies the following three different states of change:

1. *The Future State of Change*

The workforce may want change, but not necessarily the changes that have been planned. They often want others to change - not themselves.

2. *The Current State of Change*

They would rather adjust and manipulate the current methods of working than adopt new methods.

3. *The Delta State of Change*

The new way may appear highly desirable, but the process of changing looks too hard, will take too much energy, and is confusing and frightening. Moreover, it may appear that there are not enough resources of time, people and money. Consequently, people who are targets of the change end up expending the majority of their time and energy figuring out how to stop the change, or change it until it looks like something they can live with, not what was planned.

To avoid all of these states of change, it is necessary to develop the new processes with those most affected - in this case the Foremen. Monitoring the change process as it develops must also take the states of change into account as one or more of these states could manifest itself as weakness in the new system.

The manner in which changes are introduced is also critical to their success. The importance of the interface areas in this regard is of great importance. Indeed Lawrence (1968), asserts that it is not the technical aspects of a process that cause failure in a change programme, but a change in the perceived relationship between those proposing the new process and those who will work the new process. Deevy (1995) agrees with this view and insists that real change can only occur when all those affected have a real sense of ownership of the change process.

During the interviews with Company B personnel, it was evident that Foremen are given a significant degree of autonomy in the manner in which they run their projects. There is also a strong sense of respect for the Foreman at Contracts Manager/Director level. There is a danger that resistance to change could occur if the Foremen sense a change in that relationship, manifested by a lessening of the autonomy that they currently enjoy. The path to change will lie in the use of the Foremen's knowledge in developing and implementing workable new processes.

The following approach is suggested:



1. Senior management fully explains the weakness in the system and the problems arising in terms of cost under the following headings:
  - Cost of hire
  - Double hiring
  - Hiring Vs. Buying
  - Loss of profit.
2. Senior management and Foremen together set targets for improvements under each heading with a percentage of the saving to be paid as a bonus to the Foreman.
3. Senior management and Foremen together suggest means by which these targets can be met. Changes to the processes, monitoring procedures and implementation programme are fully debated and agreed by all.
4. Foreman are updated monthly on improvements and bonuses promptly paid at agreed times.

Implementation of change using these procedures would preserve and enhance the current Foreman/Management relationship and could be used as a model for approaching other change within the organisation.

#### 4.9 Industry-wide issues arising from this Case Study

The industry-wide issues that have arisen in this case study can be summarised under four general - but interrelated - headings.

1. Planning
2. Training
3. Maintenance
4. Cost control.

##### 4.9.1 Planning

As with materials, as noted in Chapter 3, the use of detailed planning techniques is not an area that appears to be exploited to its potential in the Irish Construction Industry. The Estimator establishes the type of plant and the duration for which each plant item is required when allocating preliminary costs to a project. Using the Estimator's notes in conjunction with the project

programme, it is possible to build up an accurate estimate of the range, type and cost of plant required to complete a project. Carrying this process one step further, the use of computerised planning allows for the combination of plant requirements across projects and the tracking of the use of such plant through the use of an integrated projects database.

#### 4.9.2 Training

The CSCS training proposals put forward in the Strategic Review of the Construction Industry (CIC/DOE, 1997) could be funded by placing a government levy of say 0.5% on all construction works. Based on the turnover of the industry in 1998, this would yield a fund of £45 million that could be drawn down for the funding of skills training in the industry. The administration structure for such a scheme is already in place under the FÁS Construction Training Incentive Scheme (CTIS).

All operatives would be required to carry a skills card which would provide certification as a qualified construction worker who is trained in his/her specific skill area and can competently carry out his/her duties in accordance with safety, health and welfare legislation. The FÁS Construction Industry Forecasting Model, referred to in Chapter 1, could be used to establish the training required and training organisations invited to tender for the provision of such training. The target of the year 2002 for full certification of all construction workers (as set by the Strategic Review of the Construction Industry, CIC/DOE, 1997) could then be met and the skills training needs of the industry established well into the next decade.

The Trades Unions could have an influential role in the implementation of such a programme by making membership of a construction related union dependent on obtaining and maintaining the required skills.

#### 4.9.3 Maintenance

Currently all tower cranes must be tested and certified if they are allowed to operate. A similar testing procedure could be implemented for all major plant items. Costs of such testing should be weighed against the current accident rate and the level of industrial pollution, both of which are contributed to by ill-maintained plant.

Like Company B, many smaller companies do not have a planned preventative maintenance programme. The use of such a programme ensures that maintained and fully operational plant is available when required. This leads in return to a higher level of efficiency and a lower accident rate.

#### 4.9.4 Cost control

Plant costs on a project typically account for 10% of project costs. This amounts to £900 million in the Irish Construction Industry in 1998. Through the use of the planning techniques mentioned in 4.9.1 above, it would be possible to budget for plant both on a project basis and on a long-term basis. Allied to a planned preventative maintenance strategy, it would be possible to reduce to costs of plant in construction.

#### 4.10 Conclusion

This chapter has chronicled a case study of a construction company about to embark on a change programme that should lead to greater effectiveness and efficiency in the way it uses its plant. The scope of the case study was to follow the change programme up to the stage whereby the implementation of the change programme could commence.

The Generic Change Model was used in guiding the change programme through the first five stages and again its use as valuable in identifying all of the relevant issues.

The following chapter shows the model in use at all seven stages.

## Chapter 5

### Case Study 3

#### The Design, Planning and Implementation of a Structured Training Plan in a Construction Company

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## 5.1 Introduction

This chapter documents a change project from early planning and design stage, through implementation of the pilot, up to the end of its first year. The project involves the development and delivery of a new training programme in a construction company.

Aspects of Total Quality Management (TQM) and Business Process Re-engineering (BPR) are both used in this case study to plan and guide the change programme. Some aspects of the existing training system are retained, redesigned and improved. As in the previous case study, the interface areas are approached from a TQM perspective. In accordance with the established definition of BPR "*...the fundamental re-thinking and radical redesign of business processes to achieve dramatic improvements on critical contemporary measures of performance such as cost, quality service and speed*" (Hammer & Champy 1993), the remainder of the system is re-engineered.

The case study again uses the Generic Change Model to guide the change programme through a number of stages:

### Stage 1 (Sub-section 5.2)

- the challenge and preferred outcome is established

### Stage 2 (Sub-sections 5.3 and 5.6.11)

- the objectives of the project are defined

### Stage 3 (Sub-section 5.4)

- an assessment of the current training system is carried out
- the current system is evaluated against the defined aims

### Stage 4 (Sub-section 5.5)

- a new training programme is designed

### Stage 5 (Sub-section 5.6)

- a plan for the implementation of a pilot project is developed

### Stages 6 and 7 (Sub-section 5.7)

- the implementation of the pilot project begins
- the implementation of the pilot programme is monitored. The problems arising are discussed and action is taken to improve the new programme.

## 5.2 Background

Company C is a family owned firm built on a strong tradition of developing its managers from within the organisation. It values training highly and has made a number of previous attempts to develop a formal training programme which will provide the managers for the future of the company. Each of these programmes operated for short periods with varying levels of success and has produced most of the Contracts Managers and Project Quantity Surveyors who currently control the company's projects.

Company C is one of a group of companies with sister companies in the UK and Africa. It is partly due to the contact with these other companies that the directors decided to develop a structured Graduate Training Programme for young potential managers. While the tradition of the company would suggest that this is a natural development, the means by which the training programme is to be developed and implemented constitutes a major change in the system of training.

### 5.3 Aims of the Graduate Training Programme

The Directors of Company C defined the aims of the Graduate Training Programme as follows:

**Aim No. 1.** To provide managers with the necessary skills to lead the company into the first quarter of the new millennium.

**Aim No. 2.** To maximise management performance in the consolidation and augmentation of the company's current share of the construction market.

**Aim No. 3.** To prepare managers for the development of new activities into which the company will expand over the next decade and beyond.

These aims were further to give the specific, measurable objectives shown in sub-section 5.6.11.

### 5.4 The Existing Training System

The existing training system delivered training in two ways; by placing a trainee with a more senior colleague who would provide supervision until such time as the trainee could operate alone (on-site training), or; by sending the trainee to a training course (off-site training).

#### 5.4.1 On - Site Training

Under the existing training arrangements, Junior Engineers and Quantity Surveyors work alongside more experienced colleagues for a number of years until such time as they are promoted to a position of managing their own projects. The duration of this training typically takes six years, during which time the trainee is encouraged to gain Chartered Membership of a relevant Professional Institution. Three stages are identifiable in this process:

Stage 1. The trainee enters his/her chosen profession having completed a 3<sup>rd</sup> level course at diploma or degree level. During this stage, a Junior Engineer is involved in setting-out and quality control activities under the guidance of a more senior colleague. A Junior Quantity Surveyor assists a more senior colleague in measurement and general contract administration activities. This stage normally lasts for up to two years.



- Stage 2. The trainee is given some responsibility, for example, over the works of a subcontractor. Again, this work is carried out under the guidance of a more senior colleague. This stage lasts for two years.
- Stage 3. The trainee is gradually given more responsibility, in some cases being given responsibility for a small project or a section of a large project. At this stage, a more junior colleague assists the trainee. Stage 3 lasts for at least two years, by the end of which the trainee is in line for promotion to Contracts Manager or Project Quantity Surveyor as appropriate.

#### 5.4.2 Off-site Training

Formal off-site training is also given in such areas as:

- quality assurance
- safety and
- presentations.

Further training is given in specific topics as and when required. A Contracts Manager or Director identifies the need for such training and the training requested is arranged by the Quality Manager, who also had responsibility for training. In most cases, the person proposing the training becomes aware of a specific upcoming course and recommends that the trainee attends the course. If a specific training need arises from circumstances within a trainee's work situation, then the trainee is sent on the first available course which best meets that need. In some cases, trainers are brought into the company to provide training in a specific topic. This type of training up to now has concentrated on changes in the quality assurance and safety management systems.

Under the existing arrangement, most of the training of junior staff is therefore carried out at the workplace under the guidance of a more senior colleague. Most of the learning is experiential. There is little or no relationship between the on-site training and the off-site training. Off-site training is unplanned and is provided in reaction to a request or to a specific identified need. There was no formal training programme in place at the start of this study.

Under a training programme designed in the late 1980s, an attempt had been made by Company C to bring together the off-site and on-site training. As the company is the market leader and the ability of its current management is unquestionably of the highest calibre, this earlier programme had undoubtedly been successful. The company is now aware of the need to develop a new

programme if its current and future training needs are to be met. By analysing these needs against the existing training system, the level of change required can be established.

## 5.5 Assessing the Level of Change Required

### 5.5.1 Aim No.1 - Providing managers to lead the company over the next 25 years

Based on the calibre of the current Contracts Managers and Project Quantity Surveyors, it is fair to assume that some of the trainees will achieve this aim by site experience only. However, the quality of manager produced depends on:

- the experience gained
- the knowledge and skills that they have developed
- the ability of their superiors to pass on the necessary knowledge and skills.

To ensure that this aim is fully achieved by the majority of trainees, it is necessary to define the performance required and to set out a structured programme over time during which the trainee will develop the competence to perform at the required level. Research has shown that a significant proportion of project management training is never transferred to the workplace (Samphire, 1998). The transfer fails to occur because the working environment does not consolidate learning and development. To ensure maximum transfer of learning, a co-ordinated three-tier approach to competence development is proposed. Figure 5.1 illustrates Samphire's (1998) three-tier approach to competence building.

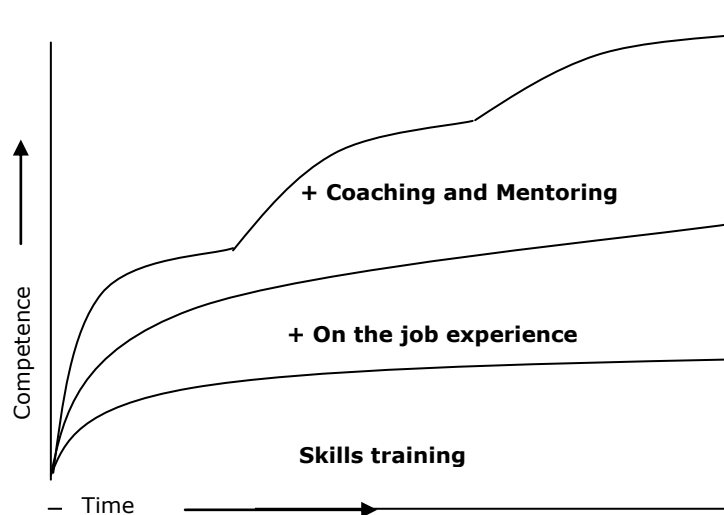


Figure 5.1 *Three-tier approach to Competence Building (Samphire 1998)*

The proposed approach is a combination of skills training, on the job experience and mentoring. A mentor is a person who provides guidance in the professional development and training of another. Close monitoring of the progress of each individual would ensure that the targets set were achieved.

Adopting this methodology would require a move from reactive approach to training to a proactive approach. It would concentrate on the needs of the future rather than the needs of the present and would involve the more senior managers in the mentoring role. Both the new approach and the use of mentoring would require greater involvement by the existing managers in the training process. Such a change would need to be planned and introduced in such a way as to ensure acceptance.

#### 5.5.2 Aim No.2 - Consolidation and augmentation of the company's current share of the construction market

In order to consolidate and augment the company's current market share, the company will require people who thrive in a changing world. Construction companies in Ireland regularly embrace new technology that makes a building process easier on site. This is evident by the continuing increase in productivity in the industry over the last ten years (CIC/DOE, 1997). Many of these changes are adopted due to the proliferation of smaller subcontractors who work for several big companies and bring new ideas and techniques from project to project. The level of change in processes slightly removed from the workforce is much slower.

The new programme must expose the trainees to new developments in construction project management. Efficiency and effectiveness of processes must be improved. New ideas, such as those in materials management and plant management raised in the previous case studies, must be explored and implemented where possible. The trainees must become aware that the need to change, innovate and improve is an essential part of their future management roles. There is no doubt that this will not be easy to achieve. It will require full support from Director level which must, at all times, be prepared to approach an innovative proposal with an open mind. In fact, it is as much a training issue at Director level as it is at Junior Engineer/ Junior Quantity Surveyor level.

#### 5.5.3 Aim No.3 - Development of new activities

While Company C has been established for over 100 years, the age profile of the line management is low, with more than 80% of the permanent staff below the age of 50 years. Currently the company employs a large number of junior site engineering personnel. Based on

current trends in staff turnover, many of the junior staff will progress through the company and will have gained the skills and experience necessary to take up management positions in five years time. This will lead to a 100% increase of those with the skills needed to fill the position of Contracts Manager within 5 years. It is obvious that the growth of the company combined with the continuous growth of the industry will not provide the positions for which there will be people to fill.

This requires a change at organisational level with the development of new systems and new business units that will supplement and expand the current base of operations.

The current training system in Company C concentrates on reacting to technical training issues. The new programme must expose trainees to new developments in the field of general management. It must encourage the examination of areas where new ventures can be investigated and developed. It must look beyond management of construction projects and include areas such as entrepreneurial management and enterprise development.

This involves a radical shift in emphasis on training and consequently will be one of the most difficult things to achieve in the new training programme.

#### 5.5.4 Action Required

It quickly became clear that the development and implementation of the new training programme would be a catalyst for change across the organisation. Consequently it would have to be planned and designed in such a way as to gain maximum acceptance. The importance of this issue was brought to the attention of the Directors. The author devised a series of tasks to be undertaken and was granted a planning period of four months, which would culminate in the launch of the programme with a pilot group in the fifth month. The tasks to be undertaken were as follows:

- Carry out a survey of staff detailing their professions, experience, qualifications and locations
- Design and construct a Relational Database that would be used to hold and manipulate all the data produced in the survey
- Choose a pilot group for whom a training programme would be designed
- Perform a detailed Training Needs Analysis for this group
- Approach the Professional Institutions and develop a co-ordinated approach to training

- Assess and record the existing performance of the pilot group as a benchmark against which the success of the programme would be measured
- Identify the other groups and individuals who would in any way interface with the implementation of the new programme and build up their support for the programme
- Produce a budget for the pilot programme
- Plan the implementation of the pilot programme
- Train a pool of Mentors and assign them to those in the pilot group
- Ensure that everyone in the company is aware of the development of the programme and of the reasons why the pilot group is being given what might appear to be special treatment
- Identify the issues that would have the greatest influence on the success of the implementation of the programme and plan to maximise the positive effect of such issues
- Identify the factors that would emerge as potential causes of failure of the programme and to take the steps necessary to minimise the influence of such factors.

## 5.6 Planning

### 5.6.1 Survey of Staff and Training Needs

The previous training programmes had identified different levels of management skills during the training process and it was decided to retain and build on this in the development of the new programme. The first task therefore was to find out which of the trainees was operating at each level and to define the actual skills that were to be applied at each level.

To achieve this, a survey was carried out by the author, using the Training Registration Form (attached as Appendix 5.1). This was distributed to all contract line management and technical personnel (i.e. Contracts Managers, Engineers, Technicians, Quantity Surveyors and Estimators) in Company C. Approximately 50% of the forms were returned within the first two weeks. With assistance from Director level, 95% of the forms were returned within 6 weeks. The remaining 5% of those surveyed were identified as individuals who had in the past expressed a reluctance to participate in training activities. The individuals who replied were sorted into levels reflecting their experience and the positions they held in the workplace.

The levels were defined as follows:

Level 1 - those with one year or less experience since graduation

Level 2 - those with more than one year and less than three years experience

Level 3 - those with three to five years experience

Level 4 - those with more than five years experience but have not yet been promoted to Contracts Manager, Project Quantity Surveyor or Senior Estimator.

Table 5.1 shows a breakdown of the data produced by the survey.

The survey also produced data on the desired training of those surveyed. This would later be used in forming an outline of the issues in which a perceived training deficiency currently existed. With the data collected, it was now necessary to construct a relational database that would be used to manipulate and analyse the data.

### 5.1 Professions and Qualification Levels of those replying to the Staff Survey

		East	South	West	Total
Contracts Managers		15	6	5	26
Engineers	Level 4	6	4	0	10
	Level 3	10	3	5	18
	Level 2	4	5	5	14
	Level 1	6	6	13	25
Technicians	Level 4	5	2	2	9
	Level 3	3	3	2	8
	Level 2	1	0	1	2
	Level 1	0	1	2	3
Project Quantity Surveyors		12	7	9	28
Quantity Surveyors	Level 3	9	1	6	16
	Level 2	4	2	2	8
	Level 1	5	8	4	17
Senior Estimators		4	2	2	8
Estimators	Level 3	1	0	0	1
	Level 2	0	0	0	0

	Level 1	1	1	0	2
Total Responses		86	51	58	195
Total Surveyed					204

### 5.6.2 Constructing the Database

The database was required in order to record all the training information in such a form that it could be retrieved in several ways. Examples of such retrieval included reviews of training provided to a group or to an individual, filtered and sorted by location, training provider, level, profession, training topic, cost and period of time. This required the use of a relational database with a minimum of three linked tables. Forms were designed to facilitate easy entry of data and a variety of report formats were created. Once the database was built, it was run on the computer network from the central server and was password protected to prevent unauthorised access. The survey data were then entered.

### 5.6.3 Choice of Pilot Group

The Directors of Company C had prioritised a training programme for the Junior Engineers. Consequently, it was decided to take the 28 Level 1 Engineers and Technicians as the Pilot Group. While this choice satisfied the immediate priority, it did raise the prospect of perceived unequal treatment of junior staff. To counteract this situation, aspects of the Level 1 programme for Quantity Surveyors and Estimators were also to be developed while a number of off-site courses in the topics raised in the staff survey would also be provided for all of those at Levels 2 and 3.

### 5.6.4 Detailed Training Needs Analysis of the Pilot Group

In carrying out this analysis, the Director in charge of each region nominated a group of not more than six people. These groups were consulted on their perception of the training needs of those to be included on the Graduate Training Programme and the specific needs of those at Level 1, i.e. the Pilot Group. The groups were asked the following questions:

- What are the skills and knowledge one requires in order to successfully manage a large-scale construction project?
- What skills development did they feel that they had personally missed out on when they were Junior Engineers?



- What other skills did they feel would be needed in the future in light of current trends in the construction industry?

These groups identified a total of eleven areas of competence to be included in the Graduate Training Programme. They were:

1. Managing information
2. Managing quality
3. Project planning
4. Managing safety & health
5. Communications
6. Management of your own work
7. Project monitoring and control
8. Managing people
9. Financial management
10. Environmental management
11. Leadership and decision making.

Areas involving entrepreneurial skills and enterprise management issues were not to be included in Levels 1 to 3. They would be addressed at a later date in a training programme aimed at those at Level 4.

Each of the areas identified was further broken down to reflect the degree of competence required to function at each of the levels. Tasks that would normally be carried out at each level were documented. The completion of each of these tasks would be required to prove that competence had been achieved. Appendix 5.2 shows the tasks to be undertaken to prove competence in the area of Communications.

A series of off-site courses would also be provided and would be timed to coincide with the training being received on-site. Table 5.2 shows the subject areas to be covered by these courses.

## 5.2 Off-Site Training Courses

Level 1	
1-1	Induction
1-2	Interpretation of Design Information
1-3	Use of Electronic Setting-Out Equipment

1-4	Computers
Level 2	
2-1	Waste Identification and Reduction
2-2	Finance for Engineers
2-3	Managing Building Services
2-4	Computers
2-5	Project Planning & Control
2-6	Safety Management
Level 3	
3-1	Site Management & Control
3-2	Contracts
3-3	Communications
3-4	Managing Safely in Construction (CIF course)
3-5	Environmental Management
3-6	Computers

#### 5.6.5 The Professional Institutions

The two institutions from whom members of the Pilot Group would be seeking professional qualifications were identified as The Institution of Engineers of Ireland (IEI) and The Chartered Institute of Building (CIOB). 19 of the Pilot Group possessed academic qualifications that met the requirements for Ordinary membership of the IEI, while the remaining 9 possessed academic qualifications that met the requirements for either Associate or Corporate membership of the CIOB.

Both of these institutions offered a system of experiential assessment based on a report on the experience gained followed by an interview. While it would be possible to continue with this system in the case of the IEI, the CIOB were at that time on the point of moving to a competence based system of assessment called the Professional Development Programme (PDP). The CIOB would allow the substitution of the PDP with an in-company competence based programme provided it reached the required standards. In order to keep all of those in the Pilot Group on the same programme, discussions were opened with the IEI with a view to allowing the records of the Pilot Programme substitute for the professional diary. This request was approved in principle by the IEI in November 1999, at the same time the CIOB granted approval for the Pilot Programme as an alternative to the PDP.

Both of these institutions have since followed the implementation of this Programme with a keen interest, as it is a new departure for both organisations.

#### 5.6.6 Choosing and Briefing the Mentors

Each of those in the Pilot Group was assigned a Mentor who would provide guidance and support during their period of training. The Mentors were chosen from those who had already achieved their professional qualification from the relevant institution. In most cases the Mentor was chosen by the junior Engineer and in many cases the person chosen had been actively involved in the consultation process during the design of the Pilot Programme. Consequently they were already fully supportive of the Programme and keen to ensure its success. Each of the Mentors was fully briefed on their role and of the process in general; a summary of which is attached as Appendix 5.3. This summary was adapted from Chartered Institute of Building Professional Development Programme guidance document (CIOB, 1997).

#### 5.6.7 Measurement of Existing Performance

With the levels of each area of competence now defined, the existing ability of the Pilot group was measured using a specially developed appraisal form (Appendix 5.4). The results of this appraisal would identify current skill level in this group.

The appraisal procedure involved three stages:

- the trainee rated his/her own ability against a pre-defined set of occupational functions
- the Mentor separately rated the trainee against the same criteria
- the trainee and the Mentor met to discuss and decide on agreed ratings.

A further appraisal on completion of Level 1 would show the skills gained during the first year of the Programme. However, it would not identify the skills that would have been gained had no pilot programme been in place. In order to find the true effect of the Programme, a sample group of 10 Engineers at Level 2 was also appraised using the appraisal form that had now been developed for Level 2 (Appendix 5.5). The current level of ability of this group would provide a benchmark against which the Pilot Group could be measured one year into the Pilot Programme.

#### 5.6.8 Analysis of Interface Areas

Deevy (1995) and La Marsh (1995) both point to the likelihood of the rejection of imposed change and to the increased chance of success when the change is developed within the organisation with considerable input from those who would be primarily affected. To this end a matrix was drawn up to identify those affected and the action to be taken in order to develop their support for the programme (Table 5.3). This takes the form of an interface analysis as used in Chapters 4 and 5.

The actions identified as being required to keep the support of each group were addressed and the situation was monitored for the duration of the Pilot Programme.

### 5.3 Analysis of Potential Interface Problems

Groups Affected	Interface problems	Action Required
The Pilot group	<ul style="list-style-type: none"> <li>• More time spent on training activities</li> <li>• Having a higher profile within the Company</li> <li>• Greater level of expectation</li> </ul>	<p>Fully clarify the objectives of the pilot programme and elicit suggestions for its improvement.</p> <p>Regularly seek and give feedback on progress.</p>
Other Junior staff	<ul style="list-style-type: none"> <li>• Potential danger of feeling that others were being treated more favourably</li> </ul>	<p>Deal with immediate Training Needs and involve this group in the further development of the Programme, with a view to their inclusion.</p>
Co-Workers	<ul style="list-style-type: none"> <li>• Potential danger of feeling that others were being treated more favourably</li> </ul>	<p>Address immediate training needs and seek advice in the design of a full structured plan to fully meet their training needs into the future.</p> <p>This group, as all others, must be kept fully informed of the planned timescale for rolling out the entire company training plan.</p>
Line Managers	<ul style="list-style-type: none"> <li>• Would lose some of their Junior Engineers to training activities at times when they were needed on site</li> <li>• Would be expected to participate in the further development of the training programme</li> </ul>	<p>Show how the attendance at training courses would actually reduce costs on site due to higher efficiency.</p> <p>Elicit feedback on the performance of the pilot group from line managers.</p>
Mentors	<ul style="list-style-type: none"> <li>• Would take on a new role and may be unsure of their newly assigned duties</li> </ul>	<p>Provide training in acting as a mentor and set up discussion groups in each region to provide support.</p> <p>Fully clarify the objectives of the pilot programme and elicit suggestions for its improvement.</p> <p>Regularly seek and give feedback on progress.</p>
Administrative Staff	<ul style="list-style-type: none"> <li>• Would perceive training needs of site staff as being prioritised over their needs</li> <li>• would have an extra workload due to the administration of the new programme</li> </ul>	<p>Address immediate training needs and seek advice in the design of a full structured plan to fully meet their training needs into the future.</p> <p>Keep this group informed of the planned timescale for rolling out the entire company training plan.</p> <p>Provide extra staff to cope with any increased workload.</p>

#### 5.6.9 Finalising the timetable for implementation

The design of the Pilot Programme was now complete and a timetable for implementation was to be finalised. The directors had asked that the off-site training would be spread over the full year. However, from informal discussions with site management staff, it became clear that off-site training should not take place during the Summer months (June - August), as this would be the time during which the sites would be at their busiest. It was also necessary to show the timing of off-site

courses when the Programme would be fully implemented across all levels as this would give a more realistic view of the effort required to implement the entire Programme. The production of such a schedule could then easily be costed to produce a budget for the training Programme. The schedule was prepared using PowerProject software and is attached as Appendix 5.6.

#### 5.6.10 Establishing Budget Costs for the Pilot Programme

Using Microsoft Excel, budget costs for the Pilot Programme were built up (Table 5.4).

#### 5.4 *Costs of Pilot Programme*

1-1	Induction	IR£1,120.00
1-2	Computer Skills	IR£4,200.00
1-3	Use of Electronic Setting-Out Equipment	IR£4,200.00
1-4	Interpretation of Design Information	IR£1,120.00
	Administration Costs	IR£5,000.00
	Total Costs	IR£15,640.00
	Total Payroll Costs of Pilot Group	IR£448,000.00
	Training Cost of Pilot Group as a percentage of Payroll	3.49%

#### 5.6.11 Identifying the Success Factors

At the planning stage the question of measuring the success of the programme arose and the factors by which its success would be measured were discussed. The aims of the Directors as detailed in sub-section 5.3 were of a long-term nature and were difficult to measure. Short-term objectives were required. Further discussion with the consultative groups in each region identified the following objectives:

1. Increase in the range of skills exhibited by each trainee (in excess of those which would have been gained from the existing training arrangements)
2. Increase in rate of skills acquisition
3. Reduction in staff turnover at lower levels (company records showed this rate to be approximately 15% in the year July 1997 - July 1998).

Objectives 1 and 2 could now be measured using the appraisal forms previously referred to in sub-section 5.5.7. Objective 3 could be assessed each year by reviewing the company records.

#### 5.6.12 Identifying and Planning for the Potential Failure Factors

In setting up the new training programme, the Directors were mindful of the fact that the effort put into setting up the previous programme had not been sustained. It was important therefore to find out why the programme had not been continued in order to prevent failure of the new programme. Analysis of the previous programme revealed the following:

1. The programme comprised a series of lectures on various technical and managerial topics related to the management of construction projects. The topics had been agreed following consultation with several Contracts Managers and Directors and in many cases mirrored the areas of competence in the new programme. However, while the new programme aims to monitor, control and record the gaining of competence, the previous programme was structured on the assumption that competence would be gained from applying the content of the lecture.
2. All those participating were required to attend a lecture on one evening per week in Dublin during the Winter months. This was onerous on those working outside the Dublin area and involved leaving the place of work early for one day per week. The new programme requires the trainee to attend up to four off-site training courses per year. These courses each last one full day and are run regionally. This omits the need to leave work early one day per weekly and reduces the amount of time spent travelling to courses.
3. The training was based entirely on the lectures. There was no system for recording on-site training or for relating the training to on-site experience. There was no procedure for assessment of the transfer of training to the workplace. Consequently, it was never possible to accurately quantify the success of the training programme. The off-site training courses in the new programme are timed to ensure that the transfer of training to the workplace is immediate through the completion of the competence-based tasks. The use of the appraisal system will measure the actual increase in performance.
4. Senior people who were working for the Company had delivered all the lectures. While all of these people were highly competent people, their expertise was in the field of construction and not in the design or delivery of training. In the new programme, those giving training courses would themselves first be trained in preparation and presentation of courses. Otherwise professional trainers would present courses.

The new training programme had been planned to avoid all of the weaknesses of the previous programme and other potential failure factors such as resistance and poor communication were also recognised. It was essential to monitor any emerging issues on an on-going basis during the implementation phase.



## 5.7 Implementation and Monitoring

The implementation of the Pilot Training Programme began on schedule in September 1998. The following is an analysis of the issues that arose during implementation:

### 5.7.1 Attendance

The attendance level of 80% was initially achieved. However, the Directors were unhappy with this level, as some Engineers were clearly assuming that training was a lower priority than their work on site. The Director in charge of training decided to make attendance at training courses mandatory, allowing an Engineer to be excused only by a Regional Director or Main Board Director. This brought attendance up to close on 100% with any remaining absences being accounted for through illness or family emergencies.

Some months in to the Programme, however, it was noticeable that some Regional Directors were themselves placing training further down the priority list as attendance began to fall again.

### 5.7.2 Choosing the Training Providers

While senior management had expressed a desire to source expertise within the Company, it quickly became clear that those with the expertise rarely had the time or the desire to present training topics and that outsourcing of some of the training would be required. In these cases, a number of experts in the field were asked to submit proposals to meet certain training objectives. The submittal which best met the criteria was chosen. The training would then be fully designed and delivered by the person who made the submittal. A condition of acceptance of the training proposal was that the design of a training course would involve detailed consultation with Senior Engineers and Contracts Managers within the Company.

### 5.7.3 Mentoring

While the supervisory role of a Senior Engineer over a Junior Engineer during professional training was not new to the Company, the role of Mentor was. Consequently, considerable support had to be made available to the Mentors in order to ensure that they were able to carry out their duties. This almost amounted to a training programme in its own right and involved the forming of mentoring discussion groups in each of the three regions. A resultant side effect of these groups was greater communication between projects and the development of an informal forum for resolution of other management issues.

#### 5.7.4 New Recruits

The Training Survey was a snapshot in time of the people working for the Company. By the time the Programme began, a small number of Engineers had left the Company while more had joined. This would result in constant reassessment of the Programme in view of shifting training needs.

#### 5.7.5 Training Needs of the Participants

The Pilot Training Programme had been designed to meet the needs of the majority of participants. It assumed a low skills level. Those on Level 1 of the programme were defined as those with less than one year of experience. In practice, during the Induction Course, some individuals displayed that they had gained significant experience in that year while others had gained very little. The Induction Course was therefore too basic for some while it met the needs of others. The other courses at Level 1 demonstrated similar problems. These problems arose from the level of responsibility given to Junior Engineers in the different regions and from whether or not the Engineer's studies for a degree qualification had included a one-year industrial placement prior to graduation. The use of the competence-based Programme ensured that a levelling effect occurred during Level 1 but the problems posed by different levels of skills of those entering Level 1 remains unresolved.

#### 5.7.6 Reactions from those not on the Programme

Those not in the initial group had been informed of the purpose of the Pilot Programme, but as they saw their colleagues attending courses the feeling of being treated less favourably inevitably began to surface. This situation was a potentially damaging one for the Programme and resulted in pressure being applied to the Training Department to begin a slow roll-out of the entire Graduate Training Programme. However, such a move at this time would not allow the Pilot Programme to run its course properly and would require a huge shift of resources into the planning of the overall Programme. It was decided, therefore to provide a number of short courses for all site staff in technical aspects of building, in the use of the Quality Management System and in the use of the Safety System. These areas had already been identified as priorities among the more Senior Engineers. This was in addition to the courses already being provided at Levels 2 and 3. The provision of these courses lessened the feelings of exclusion and further raised the profile of training

within the Company. The focus of dissatisfaction has now shifted to those who provided support services to the construction activities, such as the plant department, accounts, purchasing, etc. Again a short-term programme will be devised to cater for the needs of these groups.

#### 5.7.7 Certification

Initially it was planned to issue certificates of attendance to all participants on completion of each course. This procedure was too time consuming for the administrative staff and was changed. Each individual will now receive an annual summary of training completed.

#### 5.7.8 Dealing with Training Wants as opposed to Training Needs

Some Engineers became very enthusiastic in their approach to training and in the number of cases an individual approached the Training Department with requests to attend specific extra courses. Some of these requests were unrelated to the current training needs of the individual and contained details of courses that would be of no value to the Company. This situation had to be handled delicately as a refusal could result in an Engineer becoming disillusioned with the Training Programme, while an acceptance could generate numerous requests for funding of qualifications that would be of little benefit to the company. A procedure was developed for handling such requests and a Training Request Form was devised to assist in the recording and processing of such requests (See Appendix 5.7). This procedure was to be used by all company employees and will eventually become a standard procedure in the company quality assurance system.

#### 5.7.9 Development of Training Modules

A problem arose with the development of one of the training modules. Module 1-3 detailed the training needs in relation to the use of electronic setting-out equipment. However, learning to use this equipment is an ongoing process and is best done on-site rather than through off-site courses. The range of equipment in use across the company further confounded the situation. Those with expertise in the use of such equipment were already identified as those who would join the Programme at Level 3. A memo was sent to all Level 3 Engineers looking for suggestions in designing a module to meet the training needs in relation to the use of electronic setting-out equipment. Through the initiative of these Engineers, a committee was formed that designed a detailed training module in the use of this equipment. Recommendations were also made

regarding the standardisation of the purchase of such equipment. Differing levels of ability in the use of the equipment were identified and all Level 1 engineers would be trained to achieve the requirements of the first level. The designing of this module by Engineers on the Graduate Training Programme gave a sense of ownership of the programme to the Engineers involved and acted as a motivational factor in favour of the programme.

#### 5.7.10 Line Managers

The Contracts Managers on the projects on which the Engineers worked fulfilled the line management function in all cases. These people were under significant pressure to bring projects to completion on time and within budget. As construction profit margins are still low, tight control of resources is required to achieve these aims. Consequently, the loss of an Engineer for a single day can sometimes be resented, as the completion of the project is seen as the priority. This situation initially resulted in some last minute withdrawals from the off-site training courses. While the directive from the Director in charge of training insisting on the attendance at courses solved the attendance problem, it created a potential for resentment with the Contracts Managers. Attempts were made to show the Contracts Managers how the attendance at training courses would actually reduce costs on site due to higher efficiency. However, discussions with the Contracts Managers revealed that their problems were of an immediate nature while the solutions offered were of a long-term nature.

This situation is not yet resolved, but the Contracts Managers are aware that a solution is being sought and have been encouraged to put forward potential solutions.

#### 5.7.11 Senior Management

Despite the fact that the implementation of the Graduate Training Programme was now proceeding only on a Pilot basis, it began to be viewed at Director level as a problem solved. From an initial position of high involvement, the Directors now gradually turned their attention to other matters. This in turn raised two issues.

The first issue involved the moving of individuals to different Levels on the Graduate Training Programme. The Director in charge of each region had finalised the list of those at each Level and as the skills of these individuals developed, the Directors began to seek training for these individuals that had been identified as being at a higher Level in the Programme. The potential consequences of acceding to these requests were as follows:

- Putting a person on a higher level course would involve further absence from the workplace in the short-term as the person concerned would also continue to attend courses at their original level
- The sequence of training would be disrupted
- Others on the same level would feel that they were not been given the same training opportunities as those being sent on the extra courses
- Training would be given too far ahead of the opportunity to transfer the learning to the workplace.

This was explained to the Directors in charge of the regions and was accepted as being a logical argument. The Directors, however, reserved the right to alter the sequence of training for those under their control.

The second issue arose from the move from the reactive training approach to the proactive approach. It was still evident that people were being sent on training courses as a result of requests being made to Directors. This led to duplication of training and was brought under control by application of the use of the Training Request Form. Directors were advised to check if the training was already being provided before signing the form. In the event of a signed form being received approving training which would be duplicated, the Director was advised of the potential duplication and was given the option to rescind his approval of the request.

#### 5.7.12 Overall effect of the implementation of the Pilot Programme on the Company

The introduction of the Pilot Programme has had the following positive effects on the Company:

- awareness of training as a central management function has increased
- existing procedures have been up-dated and clarified
- regional management boards are now required to re-evaluate their policy on training
- manpower planning issues have been highlighted and long term strategies have been formulated to maximise the positive aspects of these issues.

#### 5.8 Conclusions drawn from this Case Study

In the previous case studies, the change process was followed up to stage 4 and 5 of the Generic Change Model. This case study differed from the others in that the change programme was implemented and all seven stages were followed. Also, while the previous case studies

concentrated closely on the search for the correct course of action in the changing processes and tasks, this study followed the design and implementation of the change programme applied to a whole system.

In doing so, aspects of two different change management approaches were used. A Total Quality Management (TQM) approach was used in the interface areas while most of the changes in tasks and processes were undertaken using a Business Process Re-engineering (BPR) approach.

As with all change projects, the acceptance of the change is dependant on the reaction of the people affected. To ensure their acceptance, widespread consultation in the design of the change was carried out and a sense of ownership of the change began to develop.

Approaching the end of the Pilot Project, the performance appraisals carried out with the Pilot Group show that skill levels have risen and a broader range of skills are in evidence. The staff turnover rate in the Pilot Group has been halved.

The Model shows that change is continuous and this project will indeed continue to develop for some years to come. In the next phase of the project is the full implementation of the Graduate Training Programme.

## SECTION 3

### ANALYSIS, CONCLUSIONS AND SUGGESTIONS FOR FURTHER RESEARCH

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This section comprises two chapters.

Chapter 6 conducts a critical analysis of the issues arising in the previous chapters and identifies the problems likely to be encountered in the implementation of change. This chapter also outlines the reasons why change is difficult to achieve in the Irish construction industry and suggestions are made as to how these difficulties could be overcome.

Chapter 7 draws conclusions from the work carried out in previous chapters and makes recommendations in relation to both the challenges faced by the Irish construction in relation to change and the need for further research into this field.



## Chapter 6

### Analysis

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## 6.1 Introduction

In the production of this document two issues have arisen that now require further analysis. These are:

1. The speed at which the construction environment changes and the inadequacy of the reaction of organisations to such change
2. The shortcomings of the literature in giving practical examples of attempts to apply change management techniques to the construction industry.

## 6.2 The Changing Construction Industry and Reactions of its Participants

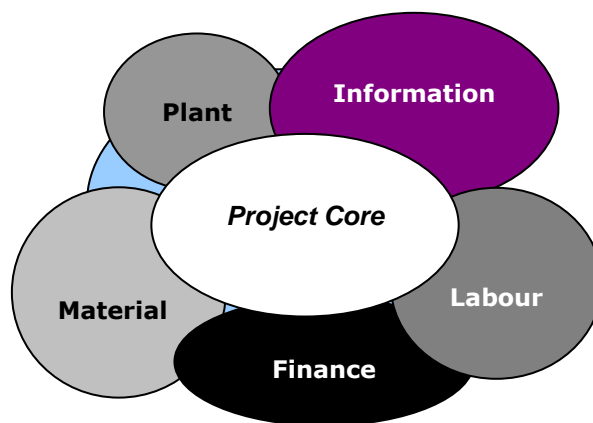
The Irish construction environment is highly fragmented and comprises clients, financiers, contractors, designers (Architects, Engineers, etc.), government agencies, trades unions, and several other diverse interest groups. Against this background, it is an enormously diverse industry producing everything from structures valued from several millions of pounds, down to routine building maintenance and repairs which are priced on hourly rates. When one combines these factors, it is not surprising that reaction to change is slow.

The construction industry differs from other industries in that its products (the buildings to be constructed) are often of a one off nature and the team that is used to produce this product (client, designer, suppliers, contractors and subcontractors) is disbanded once the product is completed. Only 20% of design information is reused in other products (Buckley, Salminen & Kesteloot, 1997).

### 6.2.1 Construction Organisations

Those who run construction organisations by and large come from a technical background and they often see the industry as a series of projects rather than an ongoing enterprise. As a project is relatively short-term, with a defined budget and time frame, those from a project background are sometimes not comfortable when confronting enterprise wide management issues such as company mission statements, strategy and long-term planning.

Each construction organisation comprises a core series of projects supported by a number of systems, as illustrated in Figure 6.1. These systems interface with each other, with each of the projects and with systems in other organisations.



*Figure 6.1 The Construction Organisation*

With this model it can be seen that if the project core (the workload) expands, the support systems must grow to meet the needs of the projects. On the other hand if the workload contracts, the systems will be downsized to match the demand. It is this dependence on the project core and the cyclical nature of construction activity that brings about a constant state of change in the supporting systems. However, it is also this constant state of change that prevents meaningful attempts at change management in the supporting systems, as the status of the systems is regarded as temporary and any effort to manage the change could be impeded by a change in the project core.

This is perhaps the main reason why construction organisations will easily grasp the concept of Just-In-Time when it comes to the delivery of concrete to site, but will have difficulty with the same concept when it involves a company-wide policy on materials management. The concept of the virtual organisation presents no difficulty when it involves the design and management of a single project but the same concept is perceived as unworkable when it is proposed in the context of using electronic commerce. Non-adversarial working relationships are regularly found on construction projects, yet it is the perception of the extent of adversary that is regularly cited as a reason for lack of co-ordinated progress in matters that are important to the development of the industry as a whole. Information technology will readily be applied to solve a problem on site, but the vast majority of the industry has not yet begun to look at the strategic advantages that IT could bring.

This is clearly a problem of mindset. Construction organisations can readily apply the latest management concepts and new technology in the context of the project but appear to be reluctant to apply the same principles in an organisation wide context. From this perspective we can see why a construction organisation has difficulty with planning for and coping with change. Change will affect the organisation in the future, it will have long-term effects, it will be company wide, and it is not specific to any one project. To cope with change, a construction organisation must take a more global view of its operations, shifting emphasis from a project approach to a more entrepreneurial approach. Skills development would be required in:

- Long-term financial planning and control
- Product/service development
- Process analysis
- Marketing.

It is essential that the skills of project management are supplemented with general management skills as one moves into and progresses into management at a level above that of project/contracts manager. Only with this approach will a construction organisation move from a project centred approach to an enterprise centred approach.

#### 6.2.2 Government Agencies

In 1998, the construction industry increased its apprentice intake to 4,600 (CIF, 1999). This figure matched the FÁS (1997) predictions in relation to the future need for apprentices. However, an increase in numbers recruited alone, will not solve the problem of a shortage of qualified tradespeople as the system used to provide the training is not now able to cope with the current volume of trainees. This is a result of the government decision to replace the existing time-based apprenticeship training system with a standards based system. The standards based apprenticeship requires the apprentice to complete seven phases of training. Phase 2 is 20 weeks duration and is conducted off the job in a FÁS training centre. Phases 4 and 6 are each of sixteen weeks duration and are conducted off the job in an educational college. The duration of apprenticeship training is four years.

Adopting this system has now led to an inability of FÁS and the educational colleges to cope with the numbers requiring off the job training at Phase 2. The problems of provision of training at Phases 4 and 6 are also becoming critical as the educational colleges appear to be unable to cope with the huge demand for places. This in turn is leading to unqualified apprentices leaving after four years without completing the seven phases and offering their services to employers at the full trade rates. The employers in turn are desperately looking for people who can carry out the work and have no choice but to employ unqualified tradespersons. This situation is typical of inadequate analysis of the potential for change and it illustrates what happens when only part of the required change is addressed.

To cope with long-term change, it is necessary to examine all of the potential possibilities for change, to address all of the factors that could arise and to constantly monitor the situation to ensure that the course of action taken is still adequate to solve the problem. It is sometimes also necessary to apply some original thinking to a problem before a suitable solution can be found. To paraphrase Covey (1989) "... the thinking that is used to solve a problem must be of a higher level than that which created the problem."

This country has undergone dramatic change over the last 15 years, yet the operation of government agencies has changed little in that time. Many initiatives are devised as a political

reaction to existing circumstances rather than as a proactive initiative designed to create a set of ideal circumstances in the future. The time taken to produce an initiative is often too long; resulting in the problem being much bigger or having significantly changed by the time the initiative is implemented. As in the example of the apprenticeship problem, the level of analysis in the development is often inadequate leading to new problems being created by the initiative itself. Indeed the agencies that deal with the construction industry are scattered across several government departments creating confusion, duplication of services and areas not covered by any department.

This approach is not adequate to deal with the challenges posed by the rapidly changing construction environment that now exists. Based on the size of the industry alone, the time is surely right for the creation of a full government department with responsibility for the construction industry. The output of the construction industry is now far in excess of the output of others such as agriculture, tourism and the marine, all of which have full government departments. The existence of such a department, headed by a senior government minister, would provide the single responsible body necessary to harness the potential of the construction industry.

### 6.3 The Change Management Literature

When Hammer (1990) first introduced Business Process Re-engineering (BPR), he cited such industries as the motor and financial services industries through which BPR could be combined with extensive introduction of Information Technology in order to achieve radical change. Some years later, the T40 project (McGeorge and Palmer, 1997) provided an example of how BPR could be used in construction. Since that time there is little or no research available showing the use of BPR in construction. Total Quality Management (TQM) was originally applied to manufacturing industry but has been applied several times to construction, (Arditi and Gunaydin (1997), Total Quality Management Task Force (1993), Baxendale and Burrell (1997), Low and Chan (1997)). Similarly there are many examples of Value Engineering (VE) being applied to construction (Curtis (1993), Meng (1994), Sasaki (1994), Locke and Randall (1994)).

What is evident from the literature is that BPR and VE are used mainly to control change in tasks or in a series of tasks that make up a process. TQM, on the other hand, focuses on the interfaces between tasks and processes. It defines everyone in a system as either a supplier of a service (to the individual who performs the preceding task) or as a customer of a service (from the individual who performs the preceding task). Clearly a combination of these methods is the correct means by

which to approach change. It is also worth noting that the continuous nature of change itself must be allowed for, to adapt to a constantly changing position.

### 6.3.1 Change Management and the Construction Industry

There is little or no reference made in the literature to the nature of the cultural shifts required in the construction industry to support meaningful change. It is perhaps in the level of strategic use of Information Technology (IT) that this is most evident. IT is currently used to a limited extent in:

- Design
- Financial Management
- Planning
- Monitoring
- Reporting.

While the use of IT in construction has enormous potential, there is little investigation of the factors that have resulted in the comparatively slow take up of this technology by the construction industry. One of the reasons for the slow take up is likely to be a distrust of the change. This is compounded by the fact that so many existing software packages are incompatible and that significant investment in IT is rendered obsolete in a matter of a few years due to the rapid developments in the IT sector. The distrust is further compounded by the fact that the use of IT promised:

- To save time
- To automate tasks and thereby cut payroll costs
- To radically improve the way we work
- To use less paper.

In reality the use of IT has resulted in:

- Most people feeling that they are now busier than before
- More people being employed and thereby higher costs
- The use of the technology being incorporated into the existing processes
- The use of even more paper.

Why has this happened? Those implementing the change would undoubtedly have closely examined the specific tasks and processes to be changed and planned accordingly. Yet everyone who uses a computer will agree that the promises of IT have not been realised.

To find the cause of failure it is worth looking back at Case Study 3. In that instance, it was found that change in processes with a small pilot group affected a huge number of people in the organisation. To ignore or underestimate the effect on those outside the changed processes would have led to failure of the pilot training programme. The most likely underlying cause of the failure to change in the instance of IT implementation is therefore that those managing the change have attempted to implement a change without due regard for the other tasks and processes that would be affected. To avoid this situation it is necessary to understand the affect of one task or process on another.

Figure 6.2 illustrates a simple system that provides an excavation service. The material is dug up manually and removed by wheelbarrow.



Figure 6.2 Simple excavation system

Imagine the effect of changing the system when A is convinced that significantly more work will be accomplished by purchasing a mechanical excavator (Figure 6.3).

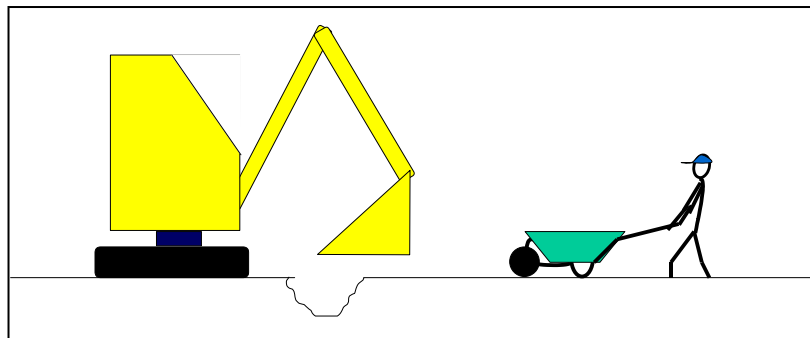


Figure 6.3 Implementation and management of the change

The lack of regard for the effect of the change on the second task causes the system to fail (Figure 6.4).

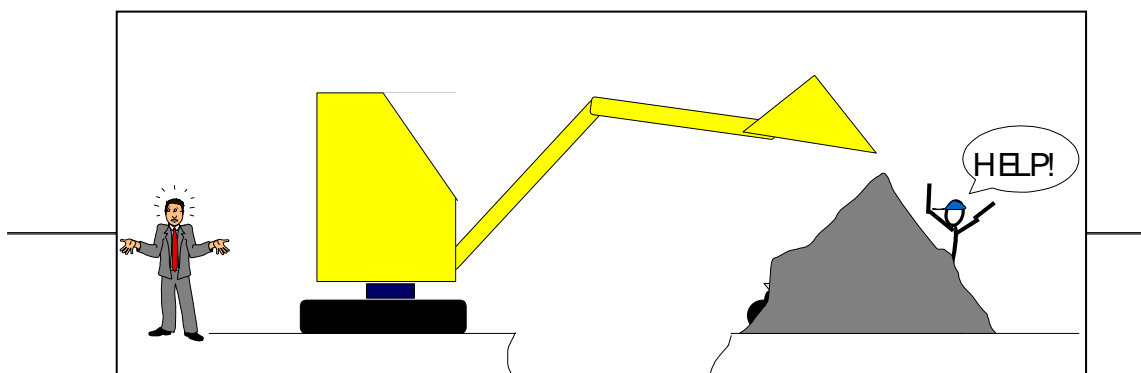




Figure 6.4 Failure in the change process

While this example has been simplified, it gives an opportunity to see where, in even the simplest of change projects, the debate as to the cause of the failure depends on who is affected. In this case, was the failure caused by:

- The excavator (substitute the words “new computerised task/process”)?
- The wheelbarrow (substitute with “affected non-computerised task/process”)?
- The system?
- The lack of analysis of the change process in relation to the interfaces?

While a case can be made for any of these four factors as the main cause of failure it is the lack of analysis in relation to the interfaces that allowed the other causes to exist. As the interfaces occur between those performing different tasks, the efficiency of the interfaces is vital to the successful operation of the processes and systems. It is therefore essential to analyse the interface areas in any change situation and thereby identify the potential problems before they arise.

This approach is not currently apparent in the implementation of IT systems into construction companies. It is the contention of this author that the use of interface analysis is central to successful change management and particularly so in the case of IT and construction.

### 6.3.2 The Continuous Nature of Change

*“You cannot step twice into the same river, for other waters are continually flowing on...”*

Heraclitus, c.500 BC, quoted from Morgan (1986).

There is an underlying similarity in all of the approaches to change. This is clearly illustrated by McGeorge and Palmer (1997), who use a conceptual model that compares the change techniques to a group of islands connected by one landmass. In all three of the case studies, it was found that

a mixture of the theories was required to cope with any one situation. Indeed change itself is continuous, as the situation requiring action will not remain static. Therefore what requires re-engineering today might require a different approach tomorrow.

This fact can cause difficulty for those planning the implementation of change, as the change must be constantly re-invented in order to remain relevant. Such a problem can be eased if the employees of the organisation “buy into” the change and become stakeholders in the process. However, construction organisations are structured in a hierarchical fashion with tight control of power all the way up the managerial chain. It is difficult to see how all those affected by a change could act in a manner that requires co-operation in the decision-making process regardless of their place in the management chain.

Deevy (1995) is adamant that the creation of such an organisation (Rapid Response Organisation) will require all employees to have access to information on financial targets and to the rate at which these targets are being achieved. Again we return to the need for a culture change. This time, however it is difficult to envisage the change occurring. The organisations that comprise the Irish construction industry guard financial information closely and even at assistant contracts manager level, information regarding the financial standing of a project will not be freely available. To these organisations, making such information freely available could be perceived as letting go of too much of the power that is currently controlled. We are unlikely therefore to see Deevy style Rapid Response construction organisations in this country in the near future. The problem of having to reinvent change programmes to react to the continuously shifting construction environment will continue to exist until those who hold power in the industry decide to gradually let go.

## Chapter 7

### Conclusions and suggestions for further research

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## 7.1 The Changing Construction Environment

The Irish construction industry exists in a changing environment. Construction organisations must become aware of the need to change and acquire the means to change if they are to gain competitive advantages.

The changes currently facing Irish construction organisations have arisen from:

1. European Union (EU) funding in the period post 1999
2. European influence generally, e.g. European Monetary Union (EMU), etc
3. Developments in Information Technology
4. The changing workforce
5. The drive for competitiveness.

Change can be introduced in a number of ways depending on the aim of the change programme. In establishing how to approach a change situation, the effect of change throughout the organisation must be assessed at all levels of activity. The four main levels of activity have been defined as:

- Task Level - at which individual actions take place as part of a process
- Process Level - at which a series of tasks are carried out
- System Level - at which number of processes are integrated and managed
- Organisational Level - at which decisions are made and actions are taken to determine the strategy of the organisation.

These levels are tied together with a complicated series of interfaces through which individuals interact with those in their own organisation and in other organisations.

The changes facing Irish construction organisations will manifest themselves differently at each level. Changes required at Task level are concerned mainly with the introduction of new technology and learning how to carry out the new tasks that result. The required changes at Process level will involve detailed analysis in an effort to find greater efficiencies and the development of new working relationships with those in other processes, systems and organisations. At Systems level, changes will be mainly concerned with promotion of innovation in the search for greater efficiency in the use of new technology and in the development of closer

working relationships with other systems and organisations. At Organisational level, the required changes will involve a cultural change to less adversarial business relationships, development of a wider business base and greater emphasis on long-term enterprise-wide issues as opposed to short-term project-centred issues.

## 7.2 Change Management in Construction

There are numerous approaches to change and the approach to be used will depend on level at which the change is to occur. The author proposes the use of a Generic Change Model (Figure 2.3, Page 39) to guide the change process.

This model comprises seven stages that can be used as a framework to manage the change. It guides the process by establishing the need for change, deriving objectives, assessing existing structures, establishing the required changes, and by planning, implementing and monitoring the change. The author also proposes the use of a matrix (Table 2.1, Page 70) in the evaluation of the available change techniques in relation to the level of activity at which the change is being considered.

This matrix shows that no single change approach will be suitable in all situations. As most changes will require action at one or more interfaces, along with action at one or more activity levels, a combination of at least two of the approaches will be required in order to achieve the required change.

## 7.3 The Findings of the Case Studies

The following findings emerged from the three case studies:

- Change management techniques can be applied to many aspects of the Irish construction industry
- Change theories can be applied to building processes in the same way as they can be applied to business processes
- Even the smallest of changes can affect the working environment of a significant proportion of those who work in the organisation
- Change at any level in the organisation must be fully investigated to assess its effect at every level and must take the interfaces between activities into account

- Change in one task or process without regard for the effect on others may cause the failure of other tasks or processes.

The use of the Generic Change Model in conjunction with an Interface Analysis was successful in all of the case studies, in that their use ensured that all of the issues critical to the success of the change programmes were identified and addressed. The model was tested in three different situations. The conclusion, based on the application of the model in these case studies, is that this model is effective, accurate, comprehensive and highly adaptable.

The case studies that were presented demonstrate the potential use of current change management techniques in the Irish construction industry but they raise further issues that would require more extensive research to resolve.

In Case Study 1, the potential for improvement in the area of materials management was examined by following Stages 1-4 of the Generic Change Model. Three different approaches were combined in this study:

1. A value engineering approach was applied to the process of materials management in order to minimise the tasks in the process
2. A re-engineering approach to the tasks that remain in the process
3. A TQM approach, with continuous improvement being actively sought in interface areas in the system.

While the case study found that there was considerable scope for increased efficiency and cost savings, the depth of this study and the limited resources available restricted the extent to which the success of the implementation of the techniques can be assessed. In order to test the findings of this case study more rigorously, a full-scale implementation of the new approach would be required. This would involve the materials management of a full project, using a partnering arrangement between the contractor and supplier. The interfaces at each level of activity and particularly at the inter-organisation level would require extensive investigation and analysis when preparing the change programme. Measurement of existing performance across a large range of materials supply situations would need to be recorded and continually monitored during the programme. The extent of the savings achieved would then determine whether or not to proceed with full implementation of the new system across the whole organisation.

In Case Study 2, a new plant management system was devised through the use of Stages 1-5 of the Generic Change Model. In order to test the findings, the full company-wide implementation of the new system would be required and the long-term benefits measured. Again, the scale of such research was beyond the scope of this project.

Case Study 3 did reach implementation of the pilot stage and continues to develop. Gradual implementation of the Graduate Training Programme is ongoing and it will eventually be expanded to cover the training activities of the entire organisation. It is mainly through the problems encountered in the development and implementation of the pilot stage that an understanding was developed of the difficulties in implementing change in the Irish construction industry. However, a return visit to Company C in two years time would be required to assess the continued level of success and would probably uncover other issues relevant to construction related change programmes.

#### 7.4 The Potential for Change

The potential for change to more effective and more efficient materials management systems was shown in Case Study 1. Using a combination of Value Engineering, Business Process Re-engineering and Total Quality Management, the conclusion of this case study was that a potential saving of 10% of materials cost could be achieved in a typical construction company.

Case Study 2 showed that with a combination of planning, training, planned maintenance and effective cost control, significant industry-wide savings could be realised in the management of construction plant.

These are but two of the possible areas that could have been chosen for investigation in this thesis. Further research is required in order to identify all of the aspects of the construction process where potential exists for increased efficiency and effectiveness.

#### 7.5 The Complexity of Change

Change is an enormously complex issue, which is possibly one of the reasons for the high failure rates of some change programmes. Case Study 3 illustrated that a change in the training system, initially concerning a pilot group of 28 people, impacted to some degree on the majority of the several hundred people employed by Company C. In this case study, it was the interface areas that required the most thought in the planning phase and the most effort in the implementation

phase. The comparison of change to a moving target was valid, as the circumstances into which the change was to be implemented themselves kept changing.

The use of the Generic Change Model was particularly effective in these circumstances as it forced the author to fully assess and constantly re-assess each interface with change.



## 7.6 Recommendations for Further Research

In summary, the following issues have been noted as being worthy of further research:

1. The possible use of supply chain management techniques in construction materials management systems
2. The potential for cost effectiveness in the construction process
3. Implementation of Information Technology systems into Irish construction organisations
4. The application of Business Process Re-engineering to business processes and construction processes in the construction industry
5. Examination of change projects carried out by Irish construction organisations
6. Further testing of the Generic Change Model in change projects across a variety of industries.

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## Appendices

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## **Appendix 1.1**

### **Survey of Computer Use by a sample number of Irish Building Contractors**

A brief telephone survey, of eight construction companies in the Dublin region, was carried out in mid February 1998 to establish the extent to which computers and different computer software packages are used in the Irish Construction Industry.

The researcher in each case asked to speak to the person in charge of computers and was put through to the person in the company who most closely fitted this profile.

All persons contacted agreed to participate in the survey.

The following information was sought:

1. The names of the software packages currently in use for
  - a) accounting
  - b) estimating
  - c) quantity surveying
  - d) project planning.
2. The extent to which these packages are integrated.
3. The extent to which computers are used on sites.

## Appendix 1.1

### Survey of Computer Use by a sample number of Irish Building Contractors

#### Findings

1. Currently Used Software Packages
  - a) Accountancy packages
    - i) Premier (2)
    - ii) Pegasus (1)
    - iii) Construction 400 (1)
    - iv) Specially written software (4)
  - b) Estimating
    - i) Buildsoft (3)
    - ii) Conquest (2)
    - iii) Manifest (2)
    - iv) Kestral (1)
    - v) Software developed “in-house” (1)
    - vi) Specially written software (1)  
(Two contractors used more than one package)
  - c) Quantity Surveying / Project Cost control
    - i) Excel or other spreadsheet (6)
    - ii) Kestral (1)
    - iii) Specially written software (1)
  - d) Project Planning Software
    - i) PowerProject (3)
    - ii) Primavera (2)
    - iii) Microsoft Project (2)
    - iv) CS Project (1)
    - v) Milestones (1)
    - vi) None (2)  
(Some companies use more than one package)
2. Integration of software in use
  - a) Total integration of software used (1)
  - b) Partial integration (linked estimating and quantity surveying software) (1)
  - c) No integration of software (6)
3. Use of computers on site

Six of the companies use computers on site. They are predominately used for quantity surveying, project planning, document control and correspondence. When asked about current use of the

## **Appendix 1.1**

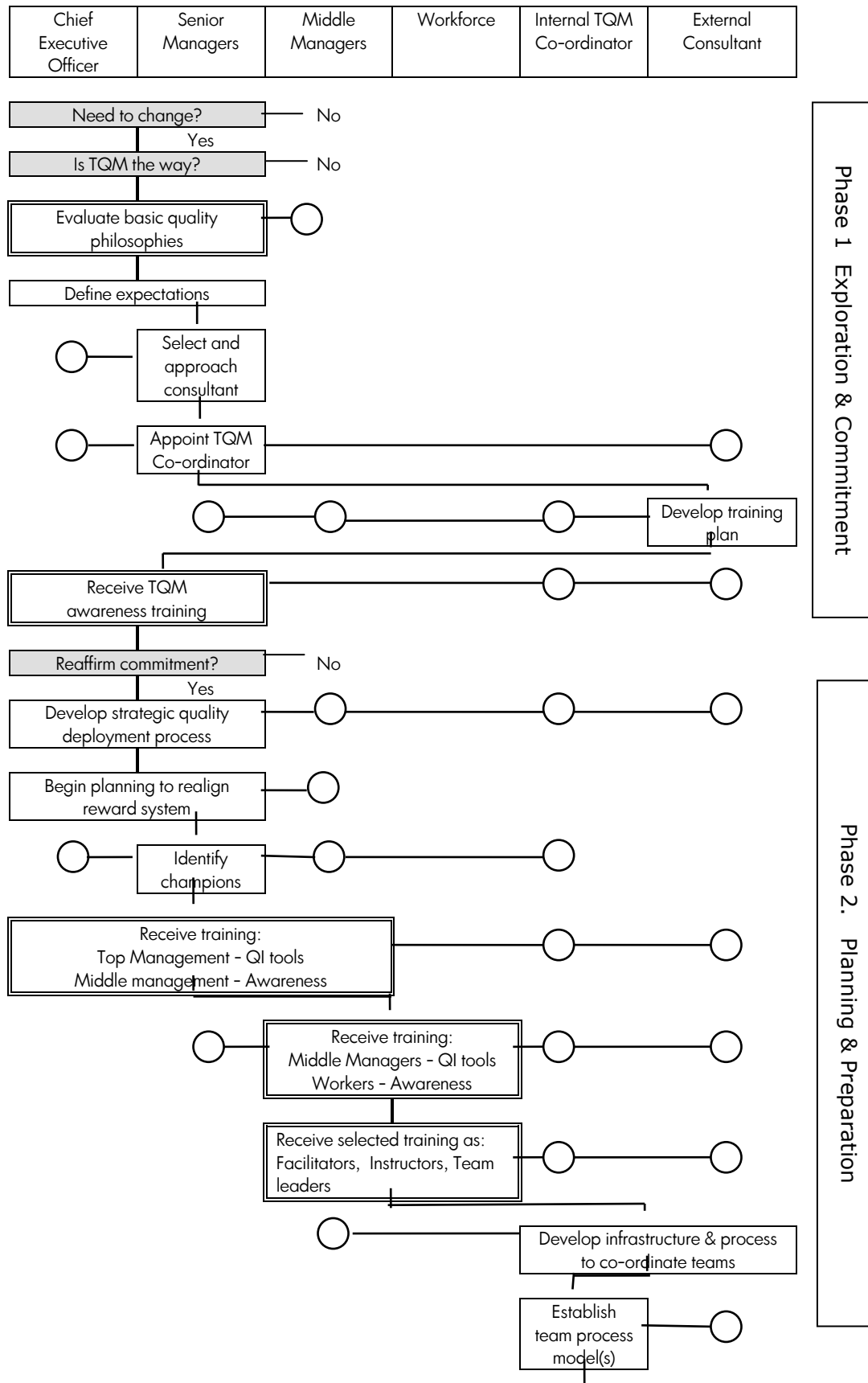
### **Survey of Computer Use by a sample number of Irish Building Contractors**

Internet, none of those surveyed stated that they were currently using the Internet in any way in their businesses.



## Appendix 2.1

### The TQM Implementation Roadmap Phases 1 & 2. (TQM Task Force 1993)



## **Appendix 2.1**

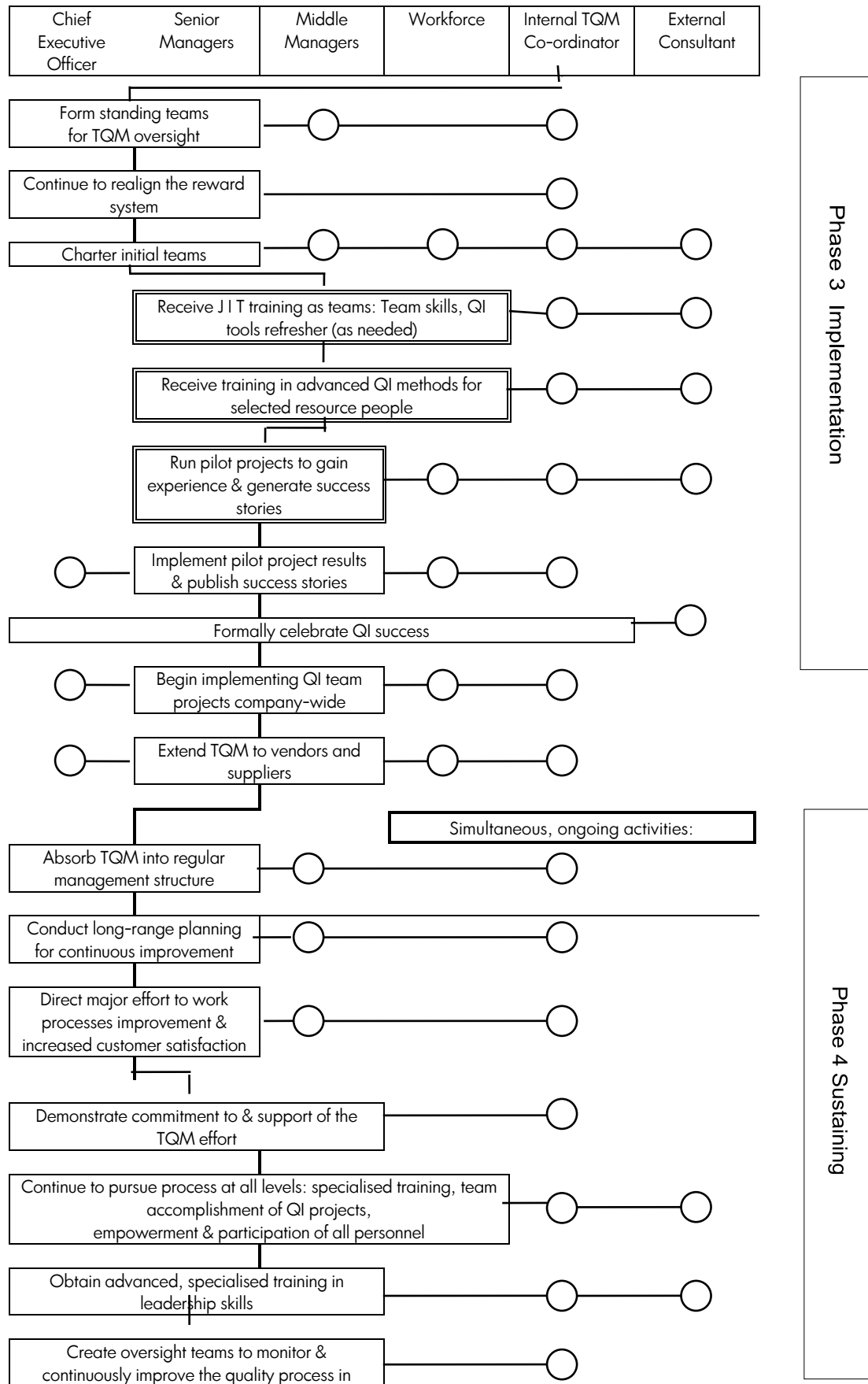
### **The TQM Implementation Roadmap Phases 1 & 2. (TQM Task Force 1993)**

To Phase 3

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## Appendix 2.1

### The TQM Implementation Roadmap Phases 3 & 4. (TQM Task Force 1993)



## **Appendix 2.1**

### **The TQM Implementation Roadmap Phases 3 & 4. (TQM Task Force 1993)**

areas of responsibility

Never-ending, company-wide process

**Appendix 3.1****Form No. 1 - Supplier Interview**

<i>Supplier Location:</i>
<i>Date:</i>
<i>Interviewee:</i>
<i>Introduction / Purpose of study</i> <ul style="list-style-type: none"><li>• <i>Efficiency study as part of M.Sc. Thesis</i></li><li>• <i>Looking at current procedures and trying to find any was they could be improved</i></li></ul>
<i>Points raised by interviewee during introduction</i>

*Process for supplying timber to Company A*

	<i>Steps in process</i>	<i>Plant used</i>	<i>Labour</i>	<i>Supervision</i>
	<i>Beginning with collection from Quay</i>			

**Appendix 3.1****Form No. 1 - Supplier Interview**

	<i>Steps in process</i>	<i>Plant used</i>	<i>Labour</i>	<i>Supervision</i>

*Costs*

Delivery from Quay	
Storage	
Average delivery time to site	
Hire cost of delivery lorry	

*Dates for observation of delivery*


**Appendix 3.1****Form No. 1 - Supplier Interview***Establishment of Administration Costs in Supply Chain*

Describe the process involved in taking an order up to the collection of the amount due on the order, giving the approximate time spent by each individual on that order		
<i>Steps in the Process</i>	<i>Person involved</i>	<i>Time (mins)</i>
<i>Other Comments:</i>		

**Appendix 3.2****Form No. 2 - Site Interview**

<i>Site:</i>
<i>Date:</i>
<i>Interviewee:</i>
<i>Introduction / Purpose of study</i> <ul style="list-style-type: none"><li>• <i>Efficiency study as part of M.Sc. Thesis</i></li><li>• <i>Looking at current procedures and trying to find any was they could be improved</i></li></ul>
<i>Points raised by interviewee during introduction</i>

*Process for ordering and taking delivery of timber*

	<i>Steps in process</i>	<i>Plant used</i>	<i>Labour</i>	<i>Supervision</i>



**Appendix 3.2****Form No. 2 - Site Interview**

	<i>Steps in process</i>	<i>Plant used</i>	<i>Labour</i>	<i>Supervision</i>

*Dates for observation*


*Other Comments:*

--

### Appendix 3.3

#### Form No.3 - Contractor's Administration Costs of Supply Chain

<i>Date:</i>
<i>Interviewee:</i>
<i>Introduction / Purpose of study</i> <ul style="list-style-type: none"><li>• <i>Efficiency study as part of M.Sc. Thesis</i></li><li>• <i>Looking at current procedures and trying to find any was they could be improved</i></li></ul>
<i>Points raised by interviewee during introduction</i>

#### *Establishment of Administration Costs in Supply Chain*

Describe the administration process involved in placing an order up to the payment of the amount due on the order, giving the approximate time spent by each individual on that order		
<i>Steps in the Process</i>	<i>Person involved</i>	<i>Time (mins)</i>

**Appendix 3.3**

**Form No.3 - Contractor's Administration Costs of Supply Chain**

*Other Comments:*

### Appendix 3.4

#### Form No.4 - Observations at Suppliers Yard

<i>Supplier Location:</i>
<i>Date:</i>

	<i>Steps in process</i>	<i>Time (load)</i>	<i>Time (bale)</i>	<i>Plant used</i>	<i>Cost</i>	<i>Labour</i>	<i>Cost</i>	<i>Total Cost of Step</i>
1	Timber transported from quay			Articulated Lorry	3% of 1.8144 m3 x £181/m <sup>3</sup>		£9.85	£9.85
2	Unloaded in suppliers yard			Forklift		Forklift Driver Storeman (20%) Foreman (10%)		
3	Timber stored in suppliers yard * (see below)	Bales are 2.4m x 1.0m = 2.4m <sup>2</sup> stacked 3 high, each takes up 0.8m <sup>2</sup> . Rent on ground = £10/m <sup>2</sup> /year					£0.23	£0.23
4	Loaded by forklift for delivery			Forklift Lorry		Forklift Driver Driver Storeman (10%) Foreman (10%)		
5	Delivery to site	120 Mins	15 mins	Lorry	£5.50	Driver	inc.	£5.50

\* The value taken was half of the total time during which any part of a specific load of timber was stored in the supplier's yard. In this case, a load of this timber would be sold in 3 weeks; therefore the average duration in storage was taken as 1.5 weeks.

### Appendix 3.5

#### Form No.5 - Observations at Construction Site

Observation No.								
Date:								
	Steps in process	Time (load)	Time (bale)	Plant used	Cost	Labour	Cost	Total Cost of Step
6	Unloading at site			Tower Crane Lorry		Crane Driver Lorry Driver Banksman Storeman Foreman (10%)		
7	Storage on site * (see below)	Bales are 2.4m x 1.0m = 2.4m <sup>2</sup> stacked 3 high, each takes up 0.8m <sup>2</sup> . Rent on ground = £10/m <sup>2</sup> /year					£0.15	£0.15
8	Removal from storage and hoisting to workplace			Tower Crane		Crane Driver Banksman Storeman Labourer Foreman (10%)		
9	Distribution at Workplace					2 Labourers Foreman (10%)		
<p>* The value taken was half of the total time during which any part of a specific load of timber was stored on site. In this case, a load of this timber would be used in 2 weeks; therefore the average duration in storage was taken as 1 week.</p>								

## **Appendix 4.1**

### ***Plant Record Form***

Site Location: .....

Project duration: .....(weeks)

#### List of Plant Items

Description	No.	Hired

Signed: .....

Date: .....

## **Appendix 4.2**

### **Analysis of the Plant Management System**

Contractor: .....

Interviewee: .....

Date: .....

Location: .....

1. PLANT PLANNING	
- who decides what plant is needed for the job ?	
- which of the following factors influence the decision: <ul style="list-style-type: none"><li>- type of operation?</li><li>- required output?</li><li>- time?</li><li>- availability of plant on other projects?</li><li>- cost?</li><li>- other (specify)?</li></ul>	
- at what stage is the decision made?	

2. PLANT CONTROL & MONITORING	
a) What are the procedures for getting plant to the site?	

**Appendix 4.2****Analysis of the Plant Management System**

b) How is the level of plant use on site monitored?	
c) What security arrangements are in place to prevent pilferage of and damage to small items of plant on site?	
d) What are the procedures for removing plant from site when it is no longer required?	

3. Obtaining plant at short notice	
a) Is plant rarely, occasionally or regularly required at such short notice that an individual must leave site to obtain it? In such a situation who would obtain the plant item?	
b) To what location would the individual go to obtain such plant? <ul style="list-style-type: none"><li>• head office?</li><li>• another site?</li><li>• a plant hire company?</li></ul>	
c) What transport would be used?	
d) On average, how long would they be off site?	



**Appendix 4.2****Analysis of the Plant Management System**

4. HIRED PLANT	
a) What the procedures for hiring plant and for returning hired plant	
b) Who is authorised to hire plant	
c) In relation to the hire cost agreements in place with plant hire companies <ul style="list-style-type: none"><li>• how often they are reviewed?</li><li>• who reviews them ?</li></ul>	
d) What % of plant on site is hired directly from the site?	
e) How is head office notified that a plant item has been hired or put off-hire?	

5. MAINTENANCE OF PLANT	
Describe briefly the maintenance programme in place for the plant owned by the Company. Does the Company use: <ul style="list-style-type: none"><li>- planned preventive maintenance?</li><li>- demand corrective maintenance?</li><li>- emergency maintenance?</li></ul>	

**Appendix 4.2****Analysis of the Plant Management System**

6. PLANT TRAINING & SAFETY	
a) Describe the safety procedures in place to ensure the safe use of plant by those directly or in-directly employed by the company	
b) Outline the training the plant operators have received and what continued training do these operators receive when new plant arrives on site in relation to: <ul style="list-style-type: none"><li>• their own safety</li><li>• the safety of others working close to plant</li></ul>	
c) How regularly is each plant item inspected to ensure that it is safe and working properly?	
d) Who inspects plant (each category of plant)?	
e) What records are kept of such examinations and inspections?	
f) Outline the procedures for taking action on result of these inspections	

**Appendix 4.2****Analysis of the Plant Management System****7. SUGGESTIONS FOR CHANGES TO THE PLANT SYSTEM**

What suggestions do you have for making the Plant System more effective and efficient?

**Appendix 5.1****Training Registration Form**

1. Name:  2. Employee Number

3. Region: (please indicate 4)

☐ Eastern ☐ Southern ☐ Western

4. Project on which you are currently employed

5. Project Number

6. Profession: (please indicate 4)

☐ Quantity Surveyor ☐ Estimator ☐ Engineer ☐ Technician ☐ Services Co-ordinator ☐ Safety Officer

7. Qualifications: (please complete)

Qualification	Profession (e.g. Engineering, Surveying, etc.)	College / Institution	Year of Award
Certificate			
Diploma			
Degree			
Post Graduate Diploma			
Professional Institute Final Exams			
Other (please specify)			

8. Experience since gaining qualification: (please indicate 4)

☐ Less than 1 year ☐ 1 year ☐ 2 years ☐ 3 years ☐ 4 years ☐ 5 or more years

9. Please indicate approximate duration of your experience in each of the following types of construction:

Type of construction	Duration (approx.)	Type of construction	Duration (approx.)
General Commercial		Government/Semi-State	
General Industrial		Institutional	
Educational		Pharmaceutical	
Financial		Electronic	
Ecclesiastical		Food	
Transport		Retail	
Hospitals		Hotel/Leisure	
Residential		Fit-Out	

10. Specific aspects of your position in which you feel training would be beneficial

--

## **Appendix 5.2**

### **Achievement of Competence in Communications**

#### Level 1

##### 5.1 Written Communication

Provide evidence of your use of written communication for the following purposes:

- Requests for guidance and/or information
- Instructions
- Clarification of procedures or of technical information

##### 5.2 Verbal Communication

Demonstrate your ability to plan and verbally seek or present information by phone or in a face-to-face situation.

#### Level 2

##### 5.1 Written Communication

**a.** Provide examples of written communication which you have prepared in the following formats:

- Condensed report
- Correspondence
  - Memo, E mail, Fax

**b.** Demonstrate your ability to analyse graphical information to check for clarity, suitability, adequacy of detail required to proceed fully with the task

## **Appendix 5.2**

### **Achievement of Competence in Communications**

Level 3

#### **5.1** Written Communication

Provide examples of written communication which you have prepared in the following formats:

- Documented report
- Letters to subcontractors, design team and others

#### **5.2** Verbal Communication

- a.** Demonstrate your ability to plan and verbally present information to various sizes and compositions of audience using a variety of visual aid equipment. This task will include a written account of the procedure used to prepare the presentation and will be supported by notes, handouts and visual aids used
- b.** Demonstrate your ability to deal with questions on aspects of your presentation which are directed to you by the audience

#### **5.3** Meetings

Provide evidence of your performance in setting up, preparing and leading meetings both within the Company and with people from outside the Company. Criteria include:

- Establishing objectives of the meeting
- Notification and clarification of objectives to participants
- Meeting structure and agenda
- Style of leadership and control
- Personal preparation
- Quality of information presented for discussion
- Personal contribution
- Obtaining the views of all participants
- Prompt & accurate production of meeting minutes

<p>GRADUATE TRAINING PROGRAMME</p> <p>PROFESSIONAL DEVELOPMENT PROCESS</p>
--

1. Graduate inducted by Mentor and a review of previous achievement undertaken.
2. Graduate identifies opportunities for development over the following six months, with line and functional managers as appropriate and produces a personal development plan.
3. Graduate discusses plan with Mentor and agrees targets.
4. Graduate discusses plan with line manager and all personnel who will be providing learning opportunities. Assessors will be notified of target for achieving competence and will provide guidance on the suitability and presentation of evidence.
5. Graduate seeks competence assessment for one or more units when she/he feels that there is sufficient evidence.
6. When satisfied with the evidence provided, the Assessor certifies the completion of each unit.
7. Graduate discusses plan with Mentor at six month review or sooner if requested. Mentor and Graduate agree achievements, confirm agreement with their signatures and begin the professional development process for the following six months.



# Professional Development Review

ENGINEER – LEVEL 1

<b>Name:</b>		<b>Project on which you are currently employed:</b>			
<b>Line Manager:</b>		<b>Region:</b> (please indicate 4)	Eastern	Southern	Western

<p>In relation to each of the statements of occupational competence outlined below, please rate your current ability level on the 1-5 scale as shown opposite.</p> <p>Include comments where you wish to clarify the reason for showing a specific rating. (Include a separate sheet if necessary.)</p> <p>Your line manager will rate your ability on a separate form and an agreed rating will be arrived at in discussion. The completed forms will be returned to the Training Department.</p>	<b>1.</b>	I do not yet have the ability to carry out this function
	<b>2.</b>	I can perform some basic aspects of this function and but need to further develop my skills
	<b>3.</b>	I can perform this function satisfactorily in most cases but still have room for improvement
	<b>4.</b>	I can consistently meet requirements in this function
	<b>5.</b>	I can fully and consistently exceed requirements in this function

	<b>Your Rating</b>	<b>Comments</b>	<b>Agreed Rating</b>
<b>1. INFORMATION MANAGEMENT</b>			
Identification, planning, co-ordination and management of the information required to complete aspects of a project.			
<b>2. QUALITY MANAGEMENT</b>			
Comprehensive use of the Quality Management System in relation to the functions of a Level 1 Engineer.			
Identification and investigation of potential building defects and taking measures to prevent reoccurrence of such defects			
<b>3. RESOURCE PLANNING</b>			
Identification of the level of resources required to complete a number of construction tasks			
Establishment of the cost of an element of work and identifying any deviation from the planned cost			
<b>4. SAFETY AND HEALTH</b>			
Classification of safety and Health problems in the construction industry			
Use of the Sisk Safety System			
<b>5. COMMUNICATIONS</b>			
Generation of correspondence and information requests as required of a Level 1 Engineer			
Planning and transmission of verbal communications			
<b>6. MANAGING YOURSELF</b>			
Clear understanding of responsibilities			
Clear understanding of duties			
Clear identification of current level of responsibility			
Identification of the standards to which you are expected to perform.			

**Performance Appraisal -Level 1**

<b>PERFORMANCE SUMMARY</b>	
<b>Areas of competence where ability requires development</b>	
<b>Signed:</b> (Engineer)	<b>Signed:</b> (Line Manager)
<b>Date:</b>	
<b>Date of next review:</b>	

**Copies to:** Engineer, Line Manager, Mentor, Training Department

# Performance Development Monitoring

ENGINEER - LEVEL 2

<b>Name:</b>		<b>Project on which you are currently employed:</b>			
<b>Line Manager:</b>		<b>Region:</b> (please indicate 4)	Eastern	Southern	Western

<p>In relation to each of the statements of occupational competence outlined below, please rate your current ability level on the 1-5 scale as shown opposite.</p> <p>Include comments where you wish to clarify the reason for showing a specific rating. (Include a separate sheet if necessary.)</p> <p>Your line manager will rate your ability on a separate form and an agreed rating will be arrived at in discussion. The completed forms will be returned to the Training Department.</p>	<b>1.</b>	I do not yet have the ability to carry out this function
	<b>2.</b>	I can perform some basic aspects of this function and but need to further develop my skills
	<b>3.</b>	I can perform this function satisfactorily in most cases but still have room for improvement
	<b>4.</b>	I can consistently meet requirements in this function
	<b>5.</b>	I can fully and consistently exceed requirements in this function

	Your Rating	Comments	Agreed Rating
<b>1. INFORMATION MANAGEMENT</b>			
Identification, planning, co-ordination and management of the information required to complete a works package or a section of the project.			
<b>2. QUALITY MANAGEMENT</b>			
Comprehensive use of the Quality Management System in relation to the functions of a Level 2 Engineer.			
<b>3. RESOURCE PLANNING</b>			
Identification, planning, co-ordination and management of the resources required to complete a works package or a section of the project.			
Identification of cost of resources and taking active measures to reduce waste.			
<b>4. SAFETY AND HEALTH</b>			
Identification of project-specific hazards and the use of both qualitative and quantitative methods of risk assessment.			
Application of the Company Safety policy and of current Safety legislation.			
<b>5. COMMUNICATIONS</b>			
Generation of all necessary correspondence and information requests as required to manage the flow of all types of information to and from the Professional team, sub-contractors and internally.			
Analysis of technical and graphical information for clarity, suitability and required adequacy of detail.			
Reporting accurately and openly to superiors and subordinates as required.			

**Appendix 5.5****Performance Appraisal -Level 2**

<b>6. MANAGING YOURSELF</b>			
Clear identification of your role.			
Clear understanding of how to carry out the functions that comprise your role.			
Identification of the level of responsibility that you are to exercise in each of your functions			
Identification of the standards to which you are expected to perform.			
Application of time management techniques in the planning and prioritising of the tasks you undertake.			
<b>7. MANAGEMENT OF DIRECT LABOUR AND OF SUBCONTRACTORS</b>			
Application of recognised motivational techniques			
Application of industrial relations legislation			
<b>8. SITE MANAGEMENT</b>			
Planning and communicating the vision of the progress of the work, using programmes and method statements internally and externally to achieve optimum production on site integrating all aspects of the site, including Sub-Contractors, suppliers, plant, safety and site presentation.			
Monitoring of progress, reviewing of programme and working methods to overcome programme and site problems.			
<b>9. FINANCIAL MANAGEMENT</b>			
Identification of opportunities to enhance company profit while maintaining and protecting the company's contractual positions.			
Showing cost awareness and assisting in obtaining extension of time and claims, to assist in the setting and management of financial targets.			

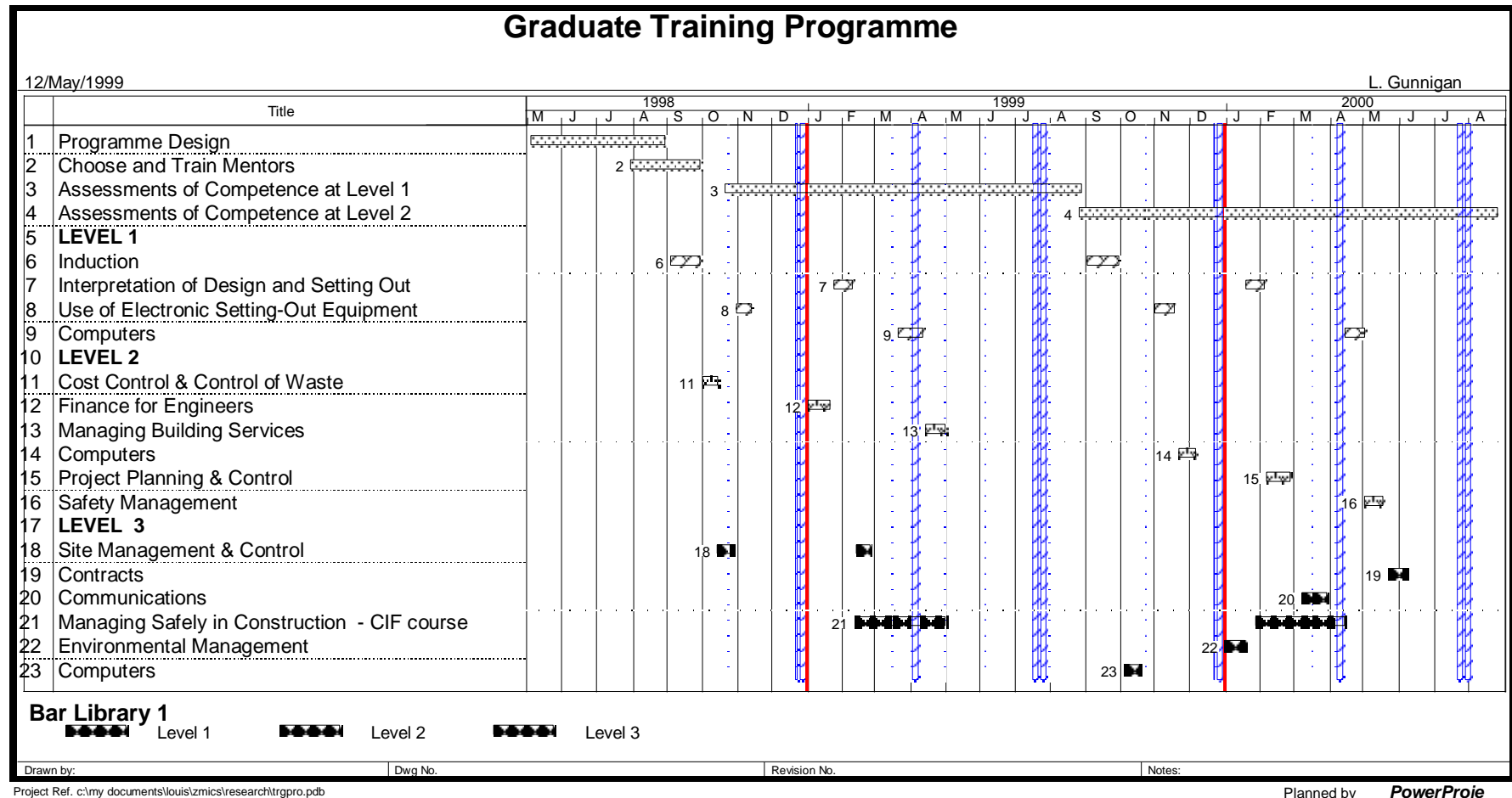
**Performance Appraisal -Level 2**

<b>PERFORMANCE SUMMARY</b>			
<b>Areas of competence where ability requires development</b>			
<b>Signed:</b> (Engineer)		<b>Signed:</b> (Line manager)	
<b>Date:</b>			
<b>Date of next review:</b>			

**Copies to:** Engineer, Line Manager, Training Department

## Appendix 5.6

### Training Programme Implementation Schedule



**TRAINING REQUEST FORM**

<i>PROPOSED TRAINEE(S)</i>			
Name	Job Title	Department / Site	Contact Tel. No
1.			
2.			
3.			

**DETAILS**

Course Title: \_\_\_\_\_

Preferred Trainer (if any): \_\_\_\_\_

Preferred Course Date(s): \_\_\_\_\_

**NOTES:**


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If the purpose of this request is to seek Company support in funding of an employee's private training, please state your case for such funding clearly identifying the following:

- the potential value of the training to the Company
- the value of the training to the applicant
- the suitability of the applicant to the course being proposed.

**TRAINING PROPOSED BY:**

Name: \_\_\_\_\_ Department/Site: \_\_\_\_\_ Date: \_\_\_\_\_

**APPROVAL BY DIRECTOR IN CHARGE**

*I have reviewed the above Training Request and I instruct the Training Department to organise the requested training.*

*Signed:* \_\_\_\_\_

*Date:* \_\_\_\_\_

*Return to:-* JOHN SISK & SON TRAINING DEPARTMENT,  
Wilton Works, Naas Road, Clondalkin, Dublin 22  
*Tel.: 01 4091500 Fax: 01 4091647 / 01 4091550*

**Important Note**

If for any reason training cannot take place, please contact a member of the Training Department IMMEDIATELY at 01 4091500

**For Office Use Only**

Course Ref:	Cost:	Date Booked:
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***TRAINING REQUEST FORM***